GUIDEBOOK for Look and Learn All Around Us How Do We Know?

by Wilbur L. Beauchamp,
Gertrude Crampton,
and William S. Gray,
Reading Director

BASIC STUDIES IN SCIENCE
BOOKS A, B, C

ULUM FOUNDATION SERIES

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Introduction

Science in the Primary Grades

One of the chief duties of the school is to stimulate and guide the all-round growth of the pupil. A fundamental aim of an adequate science program is to stimulate and guide the pupil in a constantly growing understanding of the forces, elements, materials, and living things which, together, make up his everyday world.

There is an abundance of things to interest and challenge pupils — things to watch, things to investigate, things to do, and things to discuss. All the world lies before the child, to be explained and understood in its parts and, more important still, to be understood in the interrelationships of these parts. So great is the diversity, as well as the extent, of the natural environment that an organized plan of presentation is essential if the pupils are to grasp not merely facts but relationships as well.

A course in science must present information in an efficient manner. It must insure the mastery of basic understandings. But, to be really effective, it must also foster the intellectual skills and abilities necessary for scientific thinking: the ability to observe accurately, the ability to perceive likenesses and differences, the ability to infer, the ability to generalize, and the ability to understand and use an oral science vocabulary. The three science books for primary grades, *Look and Learn*, *All Around Us*, and *How Do We Know?* and the *Teacher's Guidebook* have been carefully planned to promote the development of these skills.

A course in science may be considered successful only if it so affects the pupil that he maintains a true scientific attitude toward his total environment. Such an attitude leads to the development of accuracy in observation and report, intellectual honesty, open-mindedness, suspended judgment, the ability to see relationships, and, above all, a spirit of inquiry.

The purpose of these three science books is to present examples from the environment that will lead the pupil to see relationships and help him organize his thinking. Each book is a step in a program that helps the pupil to gain an understanding of the principles and laws of science.

Areas of Interest

In each of the books there are four centres, or areas, of pupil interest. They are as follows: in *Look and Learn* — animals, machines, weather, and plants; in *All Around Us* — animals, getting work done, weather, and plants; and in *How Do We Know?* — animals, land and water forms, plants, and wheels and levers. These areas provide a framework upon which the pupil organizes his knowledge, and also form a basis for further exploration. This broad plan of organization leads to systematic understandings rather than to massed, unrelated factual information. (For a detailed list of concepts presented in each book, see the Index to Concepts at the back of each book.)

The scientific content of these broad centres of interest in each of the three books has been determined by three types of investigation:

1. An analysis of environment to determine the problems of living that are dependent upon science for intelligent solution.
2. An analysis of these problems to discover the principles and concepts of science which provide solutions, and to determine the age and grade level of the child at which these principles and concepts may be developed experientially and scientifically.
3. An analysis of these principles and concepts to provide the basic experiences upon which learning must be based.

Little of the actual content of *Look and Learn*, *All Around Us*, and *How Do We Know?* is new or strange to the pupils, and gaps in the pupils' backgrounds can usually be filled in quickly and efficiently.

For example, few of the animals which are discussed in the first unit of each book are animals that the pupils have not seen, talked about, or heard about in stories. Consequently, the basic subject matter is usually familiar; and the manner of viewing the subject matter, making inferences,

and generalizing from it provides the new element. The pupil is guided in the organization of his information through comparing things which he already knows about but which he has probably not considered in detail and in their relationship one to another. An example from each of the books will illustrate this point. Consider pages 6-7 of *Look and Learn*. Almost every pupil is familiar with squirrels, rabbits, dogs, kittens, hens, etc. Similarly, on pages 8-9 of *All Around Us*, the pupils observe cats, dogs, rabbits, cows, and other animals with which they are familiar. In each of these lessons, the pupil is asked to compare and contrast known animals with respect to color, size, markings, body covering, number of legs, presence of wings, etc. Thus the essential work of classification is begun with familiar examples, and the pupil is able to give his full attention to the fundamental skills of comparison, contrast, and analysis. Almost every pupil will recognize the animals shown on page 21 of *How Do We Know?* He is also quite aware of the importance of mouth parts in obtaining food. Here, however, he is required to observe details of structure, to compare various types of mouth parts, and to perceive their particular function in obtaining the specific foods the animals in question eat.

The teacher will find that the content of the three books and the lesson plans avoid the stressing of *things* as such. If pupils are required merely to list what they see, their entire mental process is that of analysis for the purpose of discovering the characteristics of specific things pictured, with little regard to relationships. This process may at times be necessary, but in this book, description is never given the main emphasis, is never an end in itself.

The things pictured on the pages are to provide data to be used in the making of inferences and in the formulating of generalizations. The ideas to be gained by the study of the pictures are, of course, dependent upon the types of questions raised by the teacher. The concepts that are listed in each lesson plan can be developed only if the correct types of pupil activities are carried on.

Picture Interpretation

The simplest way to learn is through direct experience. Learning through studying realistic pictures is a step more difficult. Learning through the reading of verbal text is the most difficult, particularly at the stage where reading itself is still a learning problem.

If time and available materials in the environment permitted, perhaps the best way to teach elementary science would be through first-hand experiences. Since this method of teaching is not always possible, the authors have used pictures in *Look and Learn* and *All Around Us* to expand the child's scientific interests and to satisfy his curiosities. Practically all pupils in the first and second grades have an experiential familiarity with their environment far beyond the range of their reading ability. The picture technique used in *Look and Learn* and *All Around Us* enables the pupil to capitalize upon his broad background of experience through directed discussion of science observations. By postponing the third method (reading of verbal text) until the child has a wide reading vocabulary, the authors have avoided either making a scientific book that is unreadable by many pupils, or making a book that is readable but one in which the clarity of science concepts has been sacrificed for the sake of simplicity of vocabulary.

The interpretation of the picture pages in *Look and Learn, All Around Us*, and *How Do We Know?* goes far beyond the limitations of the verbal text. It involves not only the ability to comprehend the ideas represented by the pictures but also the ability to reflect on the essential facts or ideas presented and to evaluate them critically in order to discover relationships between them. Furthermore, the interpretation of pictures involves the ability to apply the ideas gained from their study and discussion to new situations and is most valuable in developing a meaningful science vocabulary.

The Vocabulary

An examination of *Look and Learn* and *All Around Us* will show the reader that no verbal text is presented except titles. The reason for the postponement of verbal text has already been discussed.

In *How Do We Know?* the authors have provided for the successful transition from "picture reading" to the reading of verbal text by gradually supplementing the "picture reading" with simple verbal text. This text is designed mainly to focus attention on the main concepts to be presented on the page. Thus the verbal text aids in the interpretation of the action in the

pictures, but the inherent concepts go far beyond the text.

Of the 434 different words used in *How Do We Know?* 303 have been established during the first and second school years in the New Basic Readers of the Curriculum Foundation Series. Of the remaining 131 new words, 80 are labels identifying the objects or items adjacent to them. Pages on which there are more than three new words are those which contain labels.

The suggestions in the lesson plans for establishing the meaning of important science words through oral familiarity and the vivid associations made in *How Do We Know?* with the printed forms should be sufficient for full interpretation of the verbal text.

As a reference for the teacher the 131 new words are listed on page 151 of this *Guidebook*.

Types of Pages

Pupils who have had experience with picture books or who have used pre-reading materials understand the symbolism of pictures. There are four types of picture pages used in *Look and Learn* — the *unit-picture* page, the *picture-story* page, the *generalizing* page, and the *application* page. In the second grade, with the introduction of experimentation, a fifth type of picture page, the *pictured-experiment* page, is added, and forms an integral part of *All Around Us*. In *How Do We Know?* with the introduction of labelled drawings, the *diagram* page becomes the sixth type of page in the third-grade book.

In each of the three books there is sufficient repetition of each type of page to establish in the pupil's mind a familiar pattern of procedure. Familiarity with procedure patterns allows the pupil to focus his attention upon science concepts without being confused or hampered by constantly changing methods of presentation.

The "Unit-Picture" Page: At the beginning of each unit there is a full-page orientation picture, the purpose of which is to direct the pupils' thinking toward the general content of the unit and also to give the teacher the opportunity to estimate each child's background, possible gaps in his experience and understanding, etc.

As an example of the purpose and best use of the unit-picture page, let us consider the first unit-picture in *Look and Learn*. In presenting the first unit-picture, *Animals*, the teacher should first read aloud the title. General examination of the picture with free discussion by the pupils should follow. The teacher is given a keen insight into the individual pupil's science background and oral vocabulary by such comments as: "You can tell this is going to be about animals — there are so many of them in the picture." "Look at that big dog. I have a dog." "That is a collie. My dog is a fox terrier." "I visited my uncle's farm last summer." "I never saw a farm," etc.

This type of discussion also gives the teacher an opportunity to estimate in some detail the extent of the pupils' preparation and helps her decide which points need stress and development beyond that provided in the science books and the *Teacher's Guidebook*.

When the teacher is sure that the pupils have the general idea of the picture as a whole, she should direct their attention to its specific parts. Guide the pupils' thinking by asking such questions as: "What animals do you see in the picture? Which mother animals have their babies with them? What makes you think the cow is the calf's mother? Which animals can swim? Name an animal not shown in the picture that can swim. What animals do you see that can fly? Name an animal not shown in the picture that can fly. Which animals do you see in the picture that walk or run? Name an animal not shown in the picture that can walk or run. What kind of dog is shown in the picture? (collie) How many of you have a dog? How do you take care of a dog?"

Thus the teacher will get an idea of the extent of the pupils' knowledge concerning (1) kinds of animals, (2) physical characteristics by which certain animals may be identified, (3) resemblances of baby animals to their parents, and (4) various types of animal locomotion. Recognition of individual pupil differences within the class will enable the teacher to adapt the specific lesson plans of the unit to individual and group needs.

The "Picture-Story" Page: The picture-story consists of several pictures, each of which represents an incident and all of which in sequence tell a story. The picture-story lesson, with or without verbal text, often appears in each of the three science books as a general introduction to concepts that will be more fully developed on subsequent pages. Particularly in the first-grade book, *Look and Learn*, examination of the pictures should proceed in a left-to-right direction, promoting directional orientation to the printed page in reading.

When presenting the picture-story lesson, the teacher should make sure the pupils understand that the group of pictures is to be thought of as a story. During the preliminary discussion the pupils may tell of any experiences they have had that are closely allied to those presented in the picture-story.

After the title is read, the pupils should next analyze each picture in sequence, and the teacher should ask questions to bring out the information necessary for telling the story. In a third-grade class, the text will serve as an aid in interpreting and analyzing the pictures.

When each picture has been examined, the oral story should be told by the pupils. The complexity of the story reported will depend upon their maturity and background.

The teacher may find it advisable to direct the pupils' attention to science concepts brought out in the discussion. The picture-story lesson, thus, not only is pleasure-giving but also is an efficient means of presenting the concepts to be discussed in the pages that follow.

The "Generalizing" Page: In the field of science great strides may be made in developing habits of analytical thinking, for the objectivity of science stimulates mental attitudes and skills that are greatly to be desired.

The great majority of the pages in *Look and Learn* require pupils to formulate generalizations from the pictured materials. Various kinds of activities with pictures result in generalization. For example, pages 6-7 use the process of comparison (finding likenesses and differences) to bring out the concept that animals can be distinguished from one another by their physical characteristics. Comparison is one of the most useful activities in bringing out the characteristics of a class of things and showing how things change as the conditions change. Another method of securing generalizations is to show many types of the same class of objects. For example, the generalization that most animals find or build homes (pages 22-23) is brought out by showing the homes of different animals and by questioning the pupils to bring out the necessity for homes. Generalizations also follow from a pictured sequence of events such as is shown on page 41. Analysis of the conditions present in each picture and the relation of these conditions to the events that follow provide for generalizations relating causes and effects.

Several types of generalizing pages are used in *All Around Us* and *How Do We Know?* The small pictures on these pages are arranged in varied patterns. For example, in *All Around Us* the pattern of pages such as 7 and 64 forces the recognition of likenesses and differences; the pattern of pages such as 12 and 68-69 forces the recognition of the sequential order of development; the pattern of a page such as 25 forces recognition of a main idea by many examples; and the pattern of pages such as 52-53 forces the making of inferences. Similarly, in *How Do We Know?* the pattern of pages such as 44-45 forces the recognition of likenesses and differences; the pattern of pages such as 25 forces detailed analysis; the pattern of pages such as 20-21 forces recognition of a main idea by many examples; and the pattern of pages such as 22-23 forces the making of inferences. Whatever the pattern, if the data are accurately observed, the pupils will see the relationships involved and will infer the basic science principles and generalizations.

When this type of page is introduced, the title, if one is used, should be read aloud. Then the teacher should discuss with the pupils exactly what they are to do. If, for example, they are to make simple comparisons, they should understand the procedure thoroughly. This will eliminate hit-or-miss examination of pictures. With this type of page, attention should be centred upon the problem to be solved and the technique of solving it. The preliminary work may include identification of the animals, plants, or objects pictured, and a demonstration of the procedure to be followed. It is preferable to study each problem separately rather than ask the pupils to consider fully the page as a whole. The immediate follow-up work should include justification of answers and further discussion of the problem in order to relate it to the pupils' own experiences.

The "Pictured-Experiment" Page: Experimentation is introduced in *All Around Us*, and is expanded in *How Do We Know?* and presented on a higher level of difficulty. Great care should be exercised by the teacher when presenting the technique. The problems and procedures are extremely simple, and in many cases the results are indicated. Experimentation should not be confused with hit-or-miss activity. The pupils should be led to perceive that experimentation is an orderly, logical way of solving a problem: the problem is posed, and the experimenter makes sure

he fully understands the problem; the materials are listed, and the experimenter assembles them; the procedure is shown for the experimenter to follow. He then notes his results and solves the problem by interpreting them. Obviously, experimentation involves many of the skills and attitudes much needed not only in science but also in all life situations. The teacher will observe that the lesson plans develop experimentation techniques with great care.

The "Diagram" Page: Labelled diagrams are introduced in *How Do We Know?* and great care has been taken to insure that the pupils will understand the symbolism of the diagram. Reading diagrams is an important science skill and requires a methodical, careful introduction.

The teacher should note that at this level the diagram is always accompanied by a representation in full color so that the pupils will clearly see what the diagram stands for. She should note also that the diagrams deal with subject matter which is familiar to most pupils (robin, chipmunk, butterfly, etc.).

The interpretation of labels proceeds gradually from the part-name affixed to the diagram to the part-number that serves as a name, with an adjacent key.

The "Application" Page: After concepts have been developed on the preceding types of pages in each book, summary or application pages are presented. In some cases the application page checks the pupil's ability to apply a limited number of concepts. Application pages at the end of a unit provide opportunities to apply the concepts developed throughout the entire unit.

These application pages are vitally important, for they permit the teacher to estimate frequently the pupil's understanding of basic concepts, to rectify quickly any errors in understanding, and to reassemble into larger units the concepts that have already been presented.

Skills Involved in Basic Studies in Science Series

The development of science concepts is quite properly a matter of great concern to the authors of elementary science books. However, a science program, to be of real and full value, must also develop desirable habits of accurate thinking. Consequently, definite skills and abilities which lead to accurate thinking must be developed in the science program.

The pictures, titles, and subtitles of *Look and Learn* and *All Around Us*, combined with the teaching procedures recommended, develop the following major skills:

1. Observing characteristics (Plants have different parts.)
2. Observing and comparing characteristics (Different kinds of birds have different kinds of feet, feathers, bills, etc.)
3. Observing the habits of living creatures (Animals care for their young in various ways.)
4. Observing changes in time or place (Shadows are in different places at different times of the day.)
5. Observing a series of specific cases to arrive at a concept of class (Living things are distinguished from non-living things by certain characteristics.)
6. Discovering conditions responsible for certain effects (Rise in temperature causes snow to melt.)
7. Inferring effects that follow certain conditions (Green plants excluded from light will not grow to maturity.)
8. Classifying according to a given criterion (Wind may be a helper or an enemy.)
9. Organizing events into a sequence (The children trace the stages of growth in animals.)
10. Making generalizations (Mammals have certain common characteristics.)
11. Applying generalizations (After learning that plants need light, the child is able to tell what will happen to grass covered with a plank.)
12. Making inferences (When wind bends young corn but not treetops, it is not very strong.)
13. Inferring relationships from data (The children are led to see the type of activities that are to be carried on at a given temperature.)

In *How Do We Know?* pictures and text are provided which, with the suggested teaching procedures, will involve the use of the following additional skills:

1. Inferring the relationship between structure and function
2. Using diagrams to identify structural parts
3. Learning to use a simple key in interpreting diagrams

4. Using experiments to check the validity of inferences based on observation
5. Using experiments to discover solutions to problems
6. Drawing conclusions based on experimental data
7. Recognizing the relationship of a given order of steps in experimental procedures
8. Applying the principles developed through experiments to new situations
9. Learning to follow directions that involve the use of reference material

The Lesson Plans

Because *Look and Learn* and *All Around Us* are non-reading books, and *How Do We Know?* presents only a minimum amount of verbal text, the science concepts and skills which are fully and carefully planned for each lesson may not be obvious. For this reason this *Teacher's Guidebook* has been prepared to facilitate the presentation of each lesson.

The guidebook material for the three books has been bound into one separate *Teacher's Guidebook* in order that the teacher may envisage the three books as parts of an organized series, and may gain an insight into the way in which science concepts and skills are developed throughout the three primary grades. The lesson plans are divided into the following sections:

1. **Relation to the Unit** — a statement of the part which the lesson plays in developing major science principles or concepts and of the value of the lesson in building certain desirable skills.
2. **Concepts** — a list of the major ideas embodied in the lesson.
3. **Information for the Teacher** — facts which will help in answering certain questions that may arise; also suggested preparation for the lessons, including possible demonstrations, experiments, observations, etc.
4. **Procedure**—methods for developing the concepts through interpretation of pictures and, in *How Do We Know?* of the verbal text.
5. **Extending and Enriching Activities** — suggestions for extending and enriching the pupils' understanding.

Many activities are suggested in the *Teacher's Guidebook*. Additional activities planned by the pupils and the teacher will prove valuable, especially those involving local situations. Every effort should be exerted in order to provide for full experience not only in using each of the three books, but also in carrying out the related activities. The extent of the pupil's science understanding will depend on the extent to which he interprets his own environment and experiences in response to the ideas presented in the three science textbooks.

The Appendix

This section of the *Guidebook* presents detailed directions for providing equipment, materials, and experiences that will promote learning through observing, handling, and experimenting. Such experiences develop the habit of independent inquiry, which is as valuable as exact information.

GUIDEBOOK for Look and Learn

UNIT 1 Animals

General Concepts

A. There are many kinds of animals.
B. Animals live in various environments.
C. Animals carry on activities to keep alive.
D. Man uses animals for various purposes.
(For a more detailed outline, see Index to Concepts, pages 70-72 of *Look and Learn.*)

Introducing the Book

Look and Learn should be presented as an interesting and unusual picture book. Display the book and read the title to the children. Then say, "What did you see on your way to school this morning? Tell us one thing." After several pupils have mentioned something they saw, turn to a page in *Look and Learn* which shows something mentioned by one pupil and say, "On this page I see something that Mary said she saw on her way to school. Who would like to come up and point to it? Would you like to look for a picture of something you saw?" Distribute copies of the book to the pupils and allow them to make comments about the cover. As they open the book, direct attention to the title page by a comment such as, "The name of this book is *Look and Learn.* There are many things in the book for us to look at and learn about." Let the pupils glance through the book, locating and commenting upon pictures of things they saw on their way to school and about which they would like to learn.

Page 3

Relation to the Unit: To introduce the unit's centre of interest; to enable the teacher to explore the pupils' background of experience with animals.

Procedure: There are many ways in which page 3 might be presented, and much of the discussion depends upon the interest and background of the class. After the book itself has been introduced, the page might be presented and developed in the following manner:

Show the children page 3 and have them find it in their books. Say, "This page tells us what the first part of our book is about. What do you see on this page?" The teacher should notice how many of the animals—robin, cow and calf, collie or dog, sow and baby pig, hen and chicks, duck and ducklings—are correctly named, and then give help with any unfamiliar animal names. "Have you ever seen any of these animals? Tell us about them." Encourage discussion drawn from the children's actual experiences. Then pointing rapidly to all the animals on the page ask, "What is a good name for all of these?" Elicit the generic term *animals.* "What will the first part of our new book be about? Let's glance quickly through the pages to see if we are right."

By use of the following procedure the teacher may secure definite information as to the maturity of individual pupils. Say, "Let's look through our book to see if any of these animals on page 3 are shown again." A description of each animal should precede the search, and the teacher should make careful notations of the completeness of the descriptions given by the pupils: whether descriptions are confined to color and markings, whether they include reference to general shape and structure, and whether they include detailed analysis. It is also advisable to give close attention to the habits and attitudes of the children as they search through the book for the various animals. The teacher should observe: (1) the confidence with which each child undertakes the task, (2) the method he uses (whether he leafs through at random or begins at page 4 and progresses methodically; whether he glances too casually at each page or uses good judgment in his time allotment), (3) the completeness of his search, and (4) the scope and language of his report. All such observations are helpful in evaluating the child's readiness for the concepts of *Look and Learn.*

Say, "Turn back to page 3. Do some of the animals have their babies with them? Which ones? Who has seen baby chicks? How are they like the

mother hen? Who has seen ducklings? How are they like the mother duck? How are baby chicks and ducklings different from one another? How is the baby calf like the cow? How is the pig like the sow?" Elicit that the baby animals shown resemble their mothers more than they do other animals. Be sure that the children use the names *duckling, chick, pig,* not *duckie, chickie, piggy.*

NOTE: At this time the teacher should consult the Appendix of this *Guidebook* for suggestions on providing first-hand experiences with plants and animals. The collection of insects and small mammals should be started now, so that facts gained from the study of the book may be implemented by knowledge gained from observation of the habits of animals over a long period.

Pages 4-5

Relation to the Unit: To present in story form many of the major concepts of the unit.

Information for the Teacher: The animal shown in Picture 3 is a toad. If the pupils identify it as a frog, make no issue of the matter. If the pupils themselves raise the question, have them compare the toad with the frog on page 16. Call attention to the relative smoothness of the frog's skin, the heavily webbed feet.

Procedure: Before passing out the books, display pages 4 and 5. Explain that the eight pictures tell a story of what happened to a little puppy one day when the people to whom he belonged were all away from home. Tell the pupils that the pictures are to be read like the "funnies." Indicate the order of progression on page 4 and then on page 5.

After the books have been distributed, read the title of the story and allow the pupils to scan the pictures, making comments freely before beginning a systematic study of each picture.

Tell the children that Picture 1 is the story of a lonesome puppy that had no one to play with. Have the pupils look carefully at the picture and tell what is happening. If the term *Scottie* is used, encourage its use throughout the story.

For Picture 2, ask, "What is the puppy doing now? Why do you think he is crawling under the fence?" If a pupil replies that he is running away from home, ask, "Why do you think puppy is running away?"

In discussing Picture 3, ask such questions as "What animal has Puppy met? Do you think the toad would make a good friend and playmate?" Elicit that the toad not only looks different from Puppy but moves about in a different way and that it would not make a good friend because it cannot play in the same way as the puppy. Bring out, from the humorous viewpoint, what a difficult time Puppy would have trying to race, play, dig holes, growl, etc., with the toad.

In discussing Picture 4, ask, "What is Puppy doing that shows he would not like the cow for a friend and playmate? How is the cow different from the puppy?" Most pupils will comment only on differences in size. This is generally satisfactory, but more detailed distinctions should be made if possible.

Tell the pupils that in Picture 5, Puppy didn't find a good playmate out in the country, and so he has come back to the town. Elicit that the animal he is meeting in this picture will not make a good playmate. Have the pupils tell in what way this animal is like Puppy. Elicit that the horse in this picture is working and doesn't have time to play with him.

Ask the pupils if they think the cat in Picture 6 is likely to be a good playmate, and have them tell what things in the picture help them to know.

For Picture 7, ask, "What animal is Puppy meeting here? Do you think that this animal will be a good playmate? Are the two dogs exactly alike? Is the black puppy most like the toad, the cow, the horse, the cat, or the other dog?"

Elicit that in Picture 8 Puppy has at last found a playmate and is no longer sad. Lead the pupils to make comments expressing their appreciation of the final episode of the story.

After the pupils have examined the pictures say, "Now we are ready to tell the story. How would you begin the story?" Have different pupils tell the story for each picture. If necessary, use guiding questions or comments. Encourage the use of descriptive detail. Then have one pupil tell the whole story of "A Friend for Puppy."

Extending and Enriching Activities:

1. Begin making a collection of animal pictures. Mount each picture separately, so that the collection may be used for various purposes. Note pertinent data such as breed, size, etc., on the back of each picture. (See Appendix, page 157.)
2. Read aloud some of the best-loved realistic animal stories.

Page 6

Relation to the Unit: To promote the concept that there are many kinds of animals; that animals have definite physical characteristics by which they can be distinguished; to promote the ability to perceive likenesses and differences.

Concepts:

A. Animals may differ in color and marking.
B. Animals may differ in general shape and size.
C. Animals may differ in body covering.

Procedure: Tell the pupils that each picture on page 6 has a colored line under it, and ask them how many pictures they see on page 6. Direct the pupils to look at the first picture on the page and say, "Who can name the animals in the first picture? How many of the animals in this picture look very much alike? What do we call them? (red squirrels) What is the name of the animal that is different from the others? (cottontail rabbit) In what ways is the rabbit different from the squirrels?"

Proceed in the same manner with the remaining pictures on page 6, stressing differences in color, relative size, shape of the body, body covering, marking, and number of legs (tiger kitten, four honey cockers; five black kittens, hen; four white lambs, white collie).

Page 7

Relation to the Unit: To demonstrate that animals of the same kind may have different physical characteristics; to promote ability to perceive more detailed likenesses and differences.

Concepts:

A. Animals of the same kind may differ in shape, size, color, marking, or body covering.
B. Animals of the same kind have certain common physical characteristics.

Procedure: For page 7 follow the same general procedure suggested for page 6. It is not necessary that the pupils identify the breeds of dog shown in the first picture, but the discussion may develop more efficiently if the pupils are told that the dogs shown are beagle hounds and a cocker spaniel.

Elicit that in each picture the animals are—all dogs (beagle hounds, one cocker), all birds (bluebirds, one bluejay), all caterpillars (woolly, one monarch), all cats (mongrel, one Persian). Nevertheless, differences in structure and other physical characteristics can be seen. The pupils should note differences in coat, ears, general body structure, length of hair, etc., when discussing the dogs and the cats; markings, relative size, crested head, etc., when comparing the bluebirds and the bluejay; markings and body covering of the caterpillars.

When the animals in each picture on page 7 have been compared, the pupils should be encouraged to compare the picture panels with each other. Thus: dogs with birds, caterpillars, and cats. More advanced or perceptive pupils may call attention to the retractile claws of cats when comparing dogs and cats. Questions of the following type will guide the pupils in comparing the animals pictured. "How are all dogs alike? Are different kinds of dogs more like each other than like other kinds of animals?"

After completing page 7, the pupils should consider pages 6 and 7 as a unit in order to arrive at the generalization that color alone is not a dependable criterion for distinguishing animals. Point in turn to the cats in Pictures 2 and 3 of page 6 and Picture 4 of page 7 and ask, "What is this animal? What color is it? Are all cats the same color?" Elicit that they are all cats despite color differences; that the cockers, collie, and beagles are all dogs, despite color differences. Also elicit that both the dog on page 3 and the dog in the picture at the bottom of page 6 are collies even though their colors are different.

When the lesson has been completed, the teacher should be sure that the pupil has done *more* than merely identify dog, cat, collie, etc.; *more* than recognize superficial distinctions such as color; *more*, even, than recognize differences and likenesses among the animals shown in each picture. By judicious use of the pictures on pages 3, 6, and 7, by the use of picture collections, and by observing animals, the teacher can lead the children to formulate and state for themselves the following generalizations:

1. There are many different kinds of animals.
2. We can tell one kind of animal from another by comparing color, markings, shape, size, body covering, etc.
3. Even among animals of the same group (dogs, for example) we can distinguish one from another.

No effort should be made at this level to introduce the concepts of *order*, *breed*, *species*, etc.

The pupils should use understandingly such

terms as *furs, feathers, shape, coloring, markings, hoofs, paws,* etc., and should grasp the generic meaning of the term *animal.*

Extending and Enriching Activities:

1. Using pictures, continue the work of simple comparison.
2. Observe various common animals to note fur, feathers, skin, etc.
3. Take a trip around the neighborhood to observe animals. (See Appendix, page 161, for general suggestions on field trips.)
4. Visit the zoo to note likenesses and differences in the animals there.

Pages 8-9

Relation to the Unit: To combine the concepts presented on pages 6 and 7; to promote ability to classify according to increasingly minute likenesses and differences.

Concepts:

A. Animals have definite physical characteristics by which one can be distinguished from another.

B. Species within a family have characteristics which are alike for every member of the family.

C. Species within a group may differ in color, size, shape, etc.

D. Species within a group have characteristics which are alike for every member of the group.

Information for the Teacher: If pupils ask, they may be told the breeds of the animals pictured. They are, reading from left to right: Plymouth Rock, Leghorn, Rhode Island Red chickens, and a Pekin duck; collie, Scottie, Irish setter dogs, and a goat; Duroc-Jersey, Texas razorback, spotted Poland China hogs, and a Shropshire sheep; Holstein, Guernsey, Brown Swiss cows, and a horse on page 8. On page 9, speckled trout, sunfish, walleyed pike, and a king snake; monarch, black swallowtail, mourning cloak butterflies, and a spider; bluebird, cardinal, robin birds, and a black swallowtail caterpillar; green water snake, blacksnake, rattlesnake, and a frog.

Comprehension of the fine points of distinction of trout, pike, and bass, for example, is all right *provided* it does not supplant the broader concepts the teacher seeks to develop and *provided* that such specific knowledge serves to point up the major concepts.

Procedure: Say to the pupils, "The pictures on page 8 have been divided into rows. There is a colored line between each row. How many rows of pictures do you see? Look at the first row of animals. What name do we call three of these animals? (chickens) What is the name of the animal that is not a chicken? (duck) How are the three chickens alike? How is the duck different from all the chickens? Are the different kinds of chickens more like each other than they are like the duck?" Proceed in the same manner with the other rows of pictures on pages 8 and 9.

In Row 2, page 8, the pupils should perceive that three of the animals are dogs, though of different breeds; in Row 3, three are hogs; in Row 4, three are cows. On page 9, the pupils should perceive that, in Row 1, three of the animals are fish; in Row 2, three are butterflies; in Row 3, three are birds; and in Row 4, three are snakes. No attempt should be made to teach the name of each breed, e.g., Plymouth Rock, Leghorn, etc. If, however, some pupils know the uses of the specific name, encourage its use.

In the discussion use and explain such words as *scales, fins, wings, crawl, webbed, etc.*

Extending and Enriching Activities:

1. If the pupils are sufficiently mature, comparisons may be made of the breeds shown in the terms of size, color, shape, etc.

   Reëxamine pages 6-9 as a whole, eliciting that differences in color, marking, shape, body covering, etc., constitute common distinguishing features by which we can classify animals.
2. Use the picture collection the pupils have been making for further work in classifying and comparing animals. The fineness of distinction in this work depends, of course, upon the maturity and backgrounds of the pupils. As a general, workable rule, the teacher should keep in mind that awareness and recognition of fundamental differences in broad classification of animals are more vital to the pupils' growth in science understanding than is specific knowledge of small details.
3. The animals pictured in this unit, particularly the dogs, cats, and typical pets, will arouse interest in pets. This interest can result in closer observation of animal behavior and structure. The teacher should never overlook an opportunity for actual observation, comparison, etc., but, at the same time, good judgment must be used about introducing family pets to the schoolroom situation. Fish, turtles, toads, gar-

ter snakes, and the more phlegmatic animals work out very nicely. (See Appendix, page 155.) More excitable puppies and kittens may become quite hysterical if exposed to the classroom situation for an extended period, particularly since their very presence tends to excite the children. One practical method often used is to have a pupil's mother bring the pet to school a few minutes before the end of either the morning or the afternoon session.

Page 10

Relation to the Unit: To enable the pupils to form the generalization that most baby animals are more like their parents than other animals.

Concepts:

A. Baby animals are smaller than the parents.

B. Baby animals may differ in color.

C. Baby animals may differ in minor structural details.

D. Most baby animals resemble their parents in gross structure.

Procedure: Say, "Did you ever see a baby animal? Tell me about it. Did it look like its mother?" After several children have told about baby animals they have seen, distribute the books and read aloud the title at the top of the page. Then say, "What are we going to do on this page?" (Find the mothers) Direct the children to look at the first picture on the left-hand side of the page. "Now look at the pictures on the right-hand side and find the puppies' mother. What helped you find the right mother?" Elicit similarities in color, shape, etc. Then ask, "How are the puppies different from the mother dog? Can the puppies do everything their mother can? What things can the mother do better than the puppies? When will the puppies be able to do what their mother can? When the puppies grow up, do you think they will be more and more like their mother?"

Continue in the same way with each of the other pairs of pictures. Make sure that the pupils understand that not all animal babies are the same color as their mothers or resemble them in all minute details.

When all of the pairs of baby and mother animals have been compared, raise the general questions "How are baby animals like their mothers? How are they different from their mothers?"

Extending and Enriching Activities:

1. Have the pupils match other pictures that the children may have collected of baby and mother animals.
2. Observe a mother animal and her young. If possible, take the pupils to the zoo to observe wild-animal mothers and their young, and to the farm to observe domesticated animals with their young. Since children particularly like mares and colts, every effort should be made to have pupils visit a place where they may see colts.
3. Find or draw pictures of mother animals and their young, including wild animals.
4. Tell stories of ways in which some animals care for their young. (Stories which assign human attributes to animals should be avoided.)

Page 11

Relation to the Unit: To introduce in story form the life pattern of animals.

Concepts:

A. Animals change in appearance, size, and ability to do things as they grow older.

B. The resemblance between parent and baby increases as the baby animal grows older.

Information for the Teacher: Pictures 4 and 5 show steps in training. Other steps in training, such as carrying a saddle and weight before carrying a human rider, have been omitted. If the pupils become interested in Star's training, these additional steps may be explained.

Procedure: Introduce the story by asking the pupils to tell about a horse show, a state fair, or a county fair which they have attended or heard about. Discuss the fair or show, especially local prize winners. In the discussion bring out the fact that the first prize in contests is usually shown by a blue ribbon.

Display the picture of the colt on page 10 and the horse pulling the milk wagon on page 5 and ask, "Do you think the baby horse, or colt, could do what the horse is doing?" Elicit that the colt is too young to know how to act in harness and is not strong enough to pull a heavy load. The pupils will probably point out that horses have to be broken or trained before people can use them. Discuss other ways in which people use horses.

Say, "Today we are going to look at a picture story of a horse named Star."

After the books have been distributed, read the title and tell the pupils that Star is the colt in the first picture on the upper left-hand side of the page. Then ask, "Why do you think the colt was named Star?" (Note the white blaze.)

Guide the interpretation of the pictures and the development of the narrative interpretation as suggested for pages 4-5, bringing out that Star looks much like his mother even when very young; that, as he grows, he looks more and more like her and can gallop about the fields as she does; that he has to practice over and over again before he can jump well; that only a few horses are trained well enough to win prizes at fairs or horse shows.

In the story development use such words as *colt, mare, marking, train, trainer, rider.*

Extending and Enriching Activities:

1. Have the pupils make a list of the things Star's owner probably did to care for him—feeding, providing shelter, brushing, shoeing, etc.
2. Discuss some ways in which horses are used by man.
3. Collect or draw pictures of ways in which man uses horses.
4. Draw picture strips that show other animals (dogs, birds, cats, etc.) in the stages of growing up.
5. Visit a breeding farm, training farm, or riding stable so that the pupils may become familiar with the training and treatment of saddle horses, saddling, feeding, medical care, etc.

Page 12

Relation to the Unit: To enable the pupil by thinking about himself, his brothers and sisters, parents and grandparents to become aware of the meaning of *growth.*

Concepts:

A. Babies resemble their parents and the resemblance increases as growth continues.

B. Growth involves changes in size, appearance, and ability to do things.

Procedure: The lesson may be introduced by a discussion of baby brothers and sisters, of how they are cared for, etc.

After the books have been distributed, say, "There are two stories on this page. The first is called 'Girls Grow Up,' and the second is called 'Boys Grow Up.' "

(Both a boy and a girl are shown so that the pupils may more readily identify themselves with the pictures.)

"Look at the first story, 'Girls Grow Up.' What is the mother doing in the first picture? Why doesn't the baby run outside and play by herself? What can this baby do herself? Do tiny babies eat the same food as the rest of the family? What can this baby eat? Do you think this baby can sit up? Stand up? Talk?

"Now look at the second picture. It is the same baby, but what has happened? Is this baby stronger now? How do you know?" (Baby can sit up, hold doll and block.) Tell the pupils that the baby can control some of her muscles and make them do what she wants them to do. Then ask, "Do you think she can stand, walk, pull herself up in the play pen?

"Look at the next picture. How is the little girl different from the way she is in the second picture?" Elicit that she has grown, become heavier, has many teeth, etc. "She looks just about your age, doesn't she? So you know exactly what she is able to do." Elicit that she can ride a tricycle, can dress herself, brush her teeth, wash her face and hands, tie her shoes; can feed herself; help the family. Such questions as the following should also be raised: "Do you think the little girl can read, spell, write her name, etc.?"

Proceed in the same detailed, careful manner with the remaining pictures. As each picture is compared with the picture before, three points of difference that have taken place should be noted—changes in size, changes in appearance, and changes in ability to do things. All pupils realize quickly that the human being increases in size and weight until maturity, but careful guidance is often required to lead them to realize that motor and intellectual skills develop also. The pupils should also understand clearly that physical growth continues until maturity is reached. After that, although weight and muscular and other conditions may vary, growth, as the child understands it, ceases.

Extending and Enriching Activities:

1. Have the pupils tell things they can do now, but which they could not do as babies.
2. Have the pupils discuss what they want to learn to do when they are bigger, and lead them to name some of the skills needed.

3. Discuss food as a factor in human growth. (This work may be related to the health and personal development program, if the teacher desires. See Bibliography: *Happy Days** and *Good Times.**)
4. Find out how tall and how heavy each pupil is and the height of his parents. The pupils should understand that people vary in height and weight.
5. Have pupils bring from home photographs of themselves. Arrange in chronological order. Label, "Mary Grows Up," etc.
6. Bring to school pictures of children of various ages and stages of development. Arrange these in chronological order to show how human beings change as they grow older.

Page 13

Relation to the Unit: To determine the pupils' understanding of the sequent nature of growth; to promote the ability to observe accurately.

Procedure: Read the title aloud and recall the story of Star's growing up (page 11). Distribute the books and direct the pupils' attention to the first row of pictures on the page. Ask, "What animal grows up in this row of pictures? In which picture is the horse a baby? Which picture shows the colt to be a little older? Which one shows it as a grown-up horse? In what ways is the horse different from the human baby? From the young colt?" Have a pupil tell the "growth story."

Continue in the same way with the other rows of pictures, having the pupils decide upon the correct sequential arrangement. Call attention to the spotted breasts of the baby robins, and the spotted fawn, the antlers on the buck, their absence on the doe, etc. Make sure the pupils understand that *all* baby animals are not the same color as their parents and may not resemble them in all minute details. Answers should be discussed to eliminate possible errors, and the pupils should, of course, identify the animals.

When the pupils have completed the work on pages 12 and 13, the teacher should be sure that the children are consciously aware that animals, including people, grow. They increase in height (length) and weight. Not all animals reach maturity within the same length of time. The human baby takes a number of years to reach full maturity. Animals and humans develop in various skills as well as in height and weight as they grow.

Extending and Enriching Activities:

1. Make drawings or posters to illustrate growth in animals.
2. Observe young animals.
3. Make a picture story of the life of a pet. These pictures may be used as scenes for "movies." (See page 20 of the *Guidebook.*)
4. Use a collection of animal pictures to determine, where possible, which of the animals are mature and which are babies.

Page 14

Relation to the Unit: To introduce the importance of the ability to move about as a means for animals to keep alive; to promote the ability to perceive likenesses and differences in locomotion; to promote the ability to make generalizations.

Concepts:

A. Some animals can walk, hop, or run.

B. Some animals can crawl.

C. Some animals can swim.

D. Some animals can fly.

Information for the Teacher: In view of the work to be introduced later, it is vital that the children grasp firmly the concept that animals can move about. If any child raises the question of plants moving through growth, etc., the teacher should be sure the pupils grasp the differences in semantic interpretations of the word *move.* This can be done by having a child stand perfectly still and observe in a mirror the movement of his eyelids, the swallowing movements of his throat, or the movements of his lips when he talks. Then ask the child to walk around the room.

Do not permit the pupils to get the impression that animals which fly have only that method of locomotion. No emphasis need be put on the matter unless it is evident that a pupil is making this erroneous deduction. Should this occur, have the pupils closely observe a winged animal—a fly, bird, bee, etc.

Snakes crawl by means of muscles attached to the ribs and scales of the under side. The rear edges of the scales are free. These are inserted into rough places and can be used to push the snake forward.

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The lower surface of the earthworm has little hairs, or *setae*. There are two layers of muscles in the body wall. When the earthworm moves forward, the setae in the rear part of the body dig into the ground. The circular muscles contract and this causes the animal to lengthen. Then the setae in the front part of the body dig into the ground, the longitudinal muscles contract, and the rear of the earthworm is pulled up as the body gets fatter.

The pupils, of course, should not be required to give breed names. *Sheep*, *cow*, *snake*, etc., are sufficient identification. If the pupils ask, the animals shown on the page reading from left to right are: sheep, cow, big snake (cobra), and lion; butterfly, bullhead, honey-bee, and bird (goldfinch); bumblebee, earthworm, blacksnake, and caterpillar; salmon, goldfish, tropical fish, and grasshopper.

Procedure: Introduce the lesson by some activity, such as games or songs. This may be done during the recess or music period preceding the science work and recalled to the pupils. Emphasize the fact that these games or songs require motion. Have the pupils name other activities which require ability to move from place to place. Elicit that a great deal of our time is spent moving about.

After the books have been distributed, read the title of the page and have the pupils identify the animals in the first row. Ask such questions as: "How does a sheep move from place to place? (*walks* or *runs*) How does a cow move? How does a snake move? How does a lion move? In what way are the sheep, the cow, and the lion alike? How is the snake different from the other animals in the way in which it moves?"

Proceed in a similar fashion with the other rows, identifying the animals and their characteristic types of locomotion and making the generalization that three dissimilar animals in each row are alike in one respect—their mode of locomotion.

Extending and Enriching Activities

1. Have pupils name all the animals on the page that are alike in the way they move.
2. Have pupils look through preceding pages to supplement the list above.
3. If the classroom does not have an aquarium, this would be an excellent time to introduce it. The pupils should watch and assist in placing the plants, sand, etc. (See Appendix, page 154.)
4. Observe the movements of a fish as it swims about in an aquarium or of a worm as it crawls across a piece of paper.

Page 15

Relation to the Unit: To extend the concept of locomotion and to introduce in story form the concept that animals live in various environments.

Concept: Some animals use two or more methods of locomotion.

Procedure: Develop the picture story as suggested for pages 4-5 (see pages 6 and 9 of the *Guidebook*).

Have the pupils look at the first picture. Say, "What is happening? Is the duck (mallard) a water animal? How is it different from a fish? Ducks are not water animals in the same way that fish are." Statements that the ducks are not fully submerged in the water, that they don't live "under" the water, that they (can) move about on the land, indicate a full grasp of the distinction. Say, "How can these ducks move about in water? How can the duck on the shore move? Who will show us a funny duck waddle?

"See the animal that is coming in the next picture, creeping, quietly. Why do you think the cat is walking so quietly?" Elicit that perhaps he is trying to catch the ducks and eat them.

"Now look at the third picture. What has happened? How did the ducks get away?" If the pupils say that they "ran away," say, "Well, they certainly got away. One is_____? (swimming away). And two have flapped their wings to _____?" (fly away)

"Look at the last picture. The cat looks disgusted, doesn't he? Why? What is the cat doing? He is walking very differently from the way he was walking in the second picture. What are the ducks doing?"

After the picture story has been developed, in order to elicit that the cat had one general method of locomotion, but the ducks had more than one—flying, swimming, and walking, ask "How did the cat move from place to place? How did the duck?"

Have the pupils reëxamine pages 3, 4, 8-9, 10, 13, 14, to find animals that commonly have more than one method of locomotion.

When the lesson is completed, the pupils should be clearly aware that animals can move about and that some animals can move in more than one way and in more than one environment.

More mature pupils may make the generalization that ability to move constituted one form of protection for the ducks, since it enabled them to escape from an enemy. Ability to move made it possible for the cat to seek food. Since these con-

cepts are fully presented later, the concept should not be brought up by the teacher. If the idea is brought up by pupils, discussion should be based on pupil experiences. (See Bibliography, pages 164-172.)

Extending and Enriching Activities:

1. Arrange or draw pictures to illustrate such sentences as *These animals can fly. These animals live in water and can swim, etc.* Distinction should be made between animals whose environment necessitates swimming as a means of locomotion and animals who are able to swim if it is necessary. (Thus: A dog *can* swim although it is not his customary method of locomotion.)
2. Discuss physical structures directly involved in locomotion: legs, wings, fins, and tail. (Detailed study of these structures is not recommended at this level.)
3. Make direct observation of locomotion in as many animals as possible.
4. Dramatize riddles about methods of locomotion.
5. Observe a very small animal, such as a fly, so that the pupils will understand that size has no relation to ability to move. The pupils should fully understand the meaning of *walk* (whether applied to two or to four-footed animals), *move, crawl, fly, swim, run, movement.*

Page 16

Relation to the Unit: To develop the concept that animals live in various environments; and that animals live in the environment in which they can move about.

Concepts:

A. Some animals live on land.
B. Some animals live on land and can fly.
C. Some animals live in water and swim.
D. Some animals do not live in water but are equipped to swim in or on water and find food in the water.

Procedure: Distribute the books and ask a pupil to describe the picture at the top of the page, naming all the things he sees—fields, trees, farm buildings, etc. Ask the pupils where they could find a place like this, or ask them how they know it is a farm. Be sure the pupils see that no water is shown in the picture. Bring out the idea that we call such a place *land.*

Then say, "There are four animal pictures below this large picture. Look at the first animal. How does it move from place to place? How does the lamb move? How does the butterfly move? How does the turkey move? In what other way might the turkey move? Do you think the turkey could move about in a place like the one the picture shows? Could the other three animals? How does a fish move from place to place? Could a fish live in a place like the one shown in the picture?"

Follow the same procedure with the second large picture and the animals pictured below it. Ask, "Where can ducks move about? Frogs? (in water and on land) Where can a fish live and move about? (only in the water) How does a cat move about?" If the question arises in regard to a cat's ability to swim, say that cats do not like to be in water and rarely swim.

The pupils should make the following generalization as a result of their examination and discussion of the two pictures: There is *land,* and there are animals that can live on it. There is *water,* and animals that can live in it. And *some* animals live both in water and on land, or on land and in the air.

Extending and Enriching Activities:

1. Classify pictures (see page 9 of the *Guidebook*) according to whether animals live (1) on the land, (2) in the water, (3) both on land and in water.
2. Draw the two large pictures found on page 16 of *Look and Learn,* putting in the correct animals. Add pictures of other animals which might be found in the same environment.
3. Make a field trip to observe animals in their environment.

Page 17

Relation to the Unit: To summarize the work on land, water, and land-water environments; to give practice in seeing relationships.

Information for the Teacher: Make no attempt at this level to distinguish between fish, water birds, water mammals, or reptiles. The vital problem at this point is environments and the animals that live in them. Of course, if some pupils point out that there are land turtles, agree.

Procedure: Encourage laughter and enjoyment of this page. Some child is sure to think of "Hey,

Diddle, Diddle, the cat and the fiddle," and want to recite it.

Much as children should be encouraged to enjoy the humor of the page, the teacher should be very sure that the pupils understand the science concepts involved. Say, "These are pretty silly pictures, aren't they? What's wrong with the first picture? Where does that cow that's flying around belong? (on the land) What are the other cows in the picture doing? (eating grass) If that silly cow wants to move around finding food, how should she do it? Certainly not by flying!" The pupils should be encouraged to point out that the cow is not structurally equipped for flying.

"Where does our foolish fish need to live?" Elicit that the fish is totally unequipped for living on land and that it cannot find suitable food on land. "Is there a picture on this page of a place where the fish could live and move about?"

Continue in the same way with the second picture, finding the "foolish" animals. Bring out the fact that ducks, turtles, and fish can all move about and find food in water; that a dog sometimes swims, but he cannot walk on top of water and does not find food in water; that turtles cannot fly.

Extending and Enriching Activity:

1. Draw nonsense pictures similar to the ones on page 17 of *Look and Learn.*
2. Re-draw the pictures on page 17 and put the "foolish" animals in their proper environment.

Page 18

Relation to the Unit: To present through a picture story the concept that animals must have food to live and grow.

Concepts:

A. Wild animals find food in their environment.

B. Some animals eat more than one type of food.

Procedure: Develop the picture story as suggested for pages 4-5 (see pages 6 and 9 of the *Guidebook*). In Picture 2 the bear finds berries; in Picture 3, fish; in Picture 4, honey; in Picture 5 he is rooting in a vegetable garden; in Picture 6 he is being chased out of the garden by a dog.

Help the pupils to generalize by asking, "What must the bear have in order to live and grow? (food) What must the bear do in order to get food? (move about) What did the bear eat?" The pupils should also perceive that ability to move helped the bear escape from his enemy, the dog. From their discussion of other animals they know, the pupils should perceive that *all animals*—not just bears—must be able to move about to get food, that animals must have food to live and grow, and that many animals eat several kinds of foods.

Extending and Enriching Activities:

1. Discuss how the bear's claws help him in obtaining food. (Avoid giving erroneous impressions of cause-and-effect relationships, such as "The bear has claws so that he can get food.")
2. Discuss the physical characteristics that help other wild and domestic animals get food. Confine the discussion to animals the pupils know well or can observe readily.
3. Find out what foods other wild animals eat. (No distinction between herbivorous and carnivorous animals need be made.)

Page 19

Relation to the Unit: To provide further examples of food-finding in typical environments; to indicate various types of food which animals eat.

Procedure: Introduce page 19 by recalling the third picture on page 18 or by reëxamining page 18 and naming what the bear found to eat. Suggest that animals do not all eat the same foods. Have the pupils study each row of pictures, naming the animal shown (bird or robin; squirrel; bird, gull, or water bird). Have the pupils tell what the animal is shown to be eating, where it found the food, and what physical characteristics helped it get food. Also ask pupils to name other foods they think robins, squirrels, and gulls might eat. The pupils should arrive at the generalization that animals find food where they live; that they must have food; and that ability to move is essential in food-getting.

Extending and Enriching Activities:

1. Discuss the helplessness of the baby robins in Row 1 and the ways in which they are cared for. Discuss other comparatively helpless young animals which are fed and protected by the parents. Review the work of pages 12, 13.
2. Find out what other foods the animals shown on page 19 may eat.
3. Discuss the value of birds to the farmer, stressing insect and weed-seed consumption.

4. Make posters to show the kinds of food various common animals eat.

Page 20

Relation to the Unit: To extend and summarize the concepts relating to food-finding by wild animals in their environments.

Information for the Teacher: Pheasant eats berries, buttercup tubers, beans, peas, acorns, seeds, roots, leaves, ants' eggs, maggots, grits; Quail eats berries, seeds, grasshoppers, ants, spiders, salt; Rabbit eats grass, bark, green vegetation, grapevines, young trees; Chipmunk eats berries, nuts, acorns, seeds, buds, fruit, birds' eggs; Fox eats animals and also what the animals eat.

Procedure: Tell the pupils that the fox shown at the bottom of page 20 is very much like the bear (page 18) in his eating habits, although he isn't fond of honey, as the bear is. Have the pupils look at the large picture and decide what the fox might like to eat if he lived in a woods like the one pictured. (The fox would eat the birds, the rabbit, the chipmunk, the fruits, and the berries.) Stress the fact that some animals eat *both* plants and animals.

Say, "The fox would enjoy eating every one of the animals shown. Do you think he will catch them all? Why not?" (Some of the animals will escape.) "How will they escape?"

The pupils should arrive at the following generalizations: Some animals may eat more than one type of food. Ability to move about may help animals escape from enemies. (Make it clear that an animal's enemy is not one that dislikes him, but one that wants him for food.)

Page 21

Relation to the Unit: To contrast food-getting of wild animals with that of domesticated animals; to promote the ability to compare and contrast.

Concepts:

A. Animals which are domesticated by man must be fed by him.

B. Wild animals find food in their environment.

Procedure: Introduce the page by discussing pets. Encourage the pupils to tell about their pets—what things they have been trained to do and how they are cared for.

Have the pupils examine each pair of pictures on page 21.

Say, "Some animals are tamed by people because people want to use them in different ways. One way we use them is as pets. These pictures show animals that are tame and animals that are wild. Which are the tame animals? Which are the wild ones? (Be sure the pupils understand that a wild animal is not necessarily a lion or a tiger, but is, essentially, an animal that has not been tamed.)

"Look at the animals again and find out what they are doing. Wild or tame, they are all doing the same thing. Why do you think each picture shows an animal eating?" Elicit that the animals are eating and that food-getting is a matter of vital concern to all animals. Have the pupils tell what each wild animal is eating and how it got its food and what food the pet animals are being given. (See Appendix, page 160, *Care of Animals*.) In the discussion stress that few pets would be able to adapt themselves readily to a wild environment and obtain food successfully. The pupils should have a full understanding of the words *wild* and *tame*.

Extending and Enriching Activities:

1. Continue the discussion of pets, pet training, pet care, etc.
2. Make booklets describing the proper preparation for and care of a new pet—making a bed for it, helping it adjust itself to a new home, feeding it, etc.
3. Exhibit snapshots of pets.
4. Discuss other ways in which people use animals—food, materials for clothing, transportation, etc.

Page 22

Relation to the Unit: To present, through a discussion of the various homes used by man, the basic need for shelter; to introduce various kinds of shelter used by animals.

Concepts:

A. Most birds make nests.

B. Some animals make colony homes.

C. Some animals use available shelters.

Procedure: Have the pupils examine and discuss the picture at the top of the page and the various kinds of homes for people shown in the picture. Say, "People just have to have homes, don't they? No matter where they live, they must have homes." Lead the children to talk about various kinds of homes: detached houses, semi-detached houses, apartments, house-trailers, etc.

"Why do we have to have homes?" (The home gives protection to the family from cold, rain, storm, excessive heat, etc.)

Have the pupils discuss the animal homes pictured. Be sure they understand that the bird nest is for one bird family, the ant nest is for an entire ant colony, and the squirrel did not dig the hole in the tree but found it and prepared it for a home.

Say, "What good are these homes?" Elicit that the birds' home serves to protect the fledglings from weather and enemies and gives them some measure of protection while they are comparatively helpless; that the ant-colony home protects the colony, the eggs, etc.; that a squirrel home forms shelter and protection for the adult and baby squirrels and also helps protect the squirrel against winter weather.

Upon completion of the lesson, the pupils should make the following generalizations: People have homes; their homes protect them from many dangers and inconveniences. Most animals either make or find homes. These homes help protect animals—the adults as well as their young—from weather and from enemies.

Extending and Enriching Activities:

1. Find abandoned bird nests of various kinds and compare their constructions. (Stress the cruelty of disturbing in any way occupied nests, touching bird eggs, etc.)
2. Discuss other colony homes, such as those of bees and wasps.
3. Observe an ant colony in a Lubbock ant nest. (See Appendix, page 157.)
4. Discuss other animals that take advantage of natural structures for shelter.
5. Collect pictures of animal homes.

Page 23

Relation to the Unit: To promote awareness of the many ways in which animals are of value to man, and to summarize his responsibility toward those animals he uses.

Concepts:

A. Man uses animals in various ways.
B. Man must provide shelter for the animals he uses.

Procedure: Review man's obligation to feed the animals he uses. (See page 21.)

Read the title of page 23 and have the pupils discuss each picture, telling how each animal is being cared for and why man must feed and shelter it. If necessary, point out that animals used by man have so long been removed from their natural environment that they may be unable to care for themselves if returned to it.

Direct the children's thinking as they examine the third picture by asking, "Why do you think people have made zoos?" (We are able to study and observe animals we might otherwise never see.)

Extending and Enriching Activities:

1. Make a picture collection of the different shelters that a farmer builds for his animals.
2. Visit the zoo. (Note that the natural environments of the animals are closely copied.) If possible, confer with the director and the zoo veterinary doctor about the feeding and care of the animals for which they are responsible.
3. Build birdhouses or feeding stations. (See Appendix, page 156.)
4. Find out why birds are valuable, particularly to the farmer.

Page 24

Relation to the Unit: To present some of man's uses of animals.

Concepts:

A. Some animals provide man with food.
B. Some animals provide man with materials for clothing.

Procedure: Have the pupils name the four animals and decide from which animal each pictured product is obtained. The pupils should note that more than one product is obtained from some animals: hen—eggs, meat; hog—meat (bacon); sheep—wool (sweater, mittens, cap), meat; cow—milk, ice cream, butter, cheese, meat, leather.

The pupils may add other products obtained from the four animals pictured: feathers, fur, bristles, candles, buttons, medicine, etc. Since it is a com-

mon error at this level for pupils to think of animals as a source of food only, encourage them to name other animals whose products man uses.

When the pupils have discussed the pictures on this page, they should be encouraged to review the pages of the unit to determine the many ways in which animals serve man.

Extending and Enriching Activities:

1. Visit the grocer and the butcher and find as many animal-derived foods as possible.
2. Discuss other animal-derived foods, articles of clothing, and household articles.
3. If the local situation permits, watch sheep-shearing, angora or fowl plucking.

Upon Completion of the Unit

It is helpful for the pupils to enter into some type of summarizing or culminating activity when a unit is completed, for such activities bring to the pupils' attention the concepts rather than the specific examples of the work. Time may not always permit ambitious activities, such as fairs, school exhibits, etc., but at least one science period might be valuably spent in summarizing the work. Other classes may visit the room to see a small exhibit or hear short talks about the science work. Excellent ways of summarizing are "movies" made by fastening a strip of pictures to lengths of broom handles and unrolling the pictures on a miniature stage while pupils describe the posters, booklets, picture collections, observations, and trips made during the unit.

UNIT 2 Machines

General Concepts

A. A machine is any implement or device that aids in doing work.
B. Electricity is a source of power.
(For a more detailed outline, see Index to Concepts, pages 70-72 of *Look and Learn.*)

Page 25

Relation to the Unit: To enrich and clarify the pupils' understanding of the term *machine.*

Procedure: Distribute the books and direct the pupils to turn to page 25. Encourage the pupils to comment freely, comparing the living room shown in the picture with their own living rooms.

Then say: "The little girl is cutting out paper dolls. What tool is helping her cut out the dolls? (scissors) How does she make the scissors work?" (with her hands or fingers) Have the pupils name other tools found in their homes, and lead them to infer that tools are helpers.

"Mother is using some tools to help her knit. Do you know what they are? How does Mother make the needles work?" (with her hands or fingers)

"Can you find other helpers in the picture?" (Note the telephone, the radio, the fan, etc.) Tell the pupils that these may all be called *machines.* Indicate the word and tell the pupils that *Machines* is the title of this part of the book.

Then ask: "Do you see the wires that are fastened to the telephone, fan, radio, etc.? Do you know what they are for?" Elicit that these are electric wires and that the machines shown in the picture are operated by electricity.

Such words as *work, tools, machines, electric, electricity, wires, current, plug, switch, cord,* etc., should be used and developed in the conversation, but only a small understanding of the full meaning of the electrical terms can be expected at this level.

Page 26

Relation to the Unit: To promote awareness of the convenience of machines in the homes which have electricity as their source of power, to note how many machines there are in the home, and to further extend and clarify the term *machine.*

Concepts:
A. Electricity provides light in our homes.
B. Electricity provides energy to run machines.
C. Electrical household machines are convenient.

Procedure: Have the pupils observe carefully and comment on the picture, and, if the local situation permits, compare the picture of the kitchen with the kitchens in their own homes. As the pupils mention each electrical device shown in the picture, have them tell how it is used. Have them identify any devices or machines shown in the picture which are not electrical (grinder, faucet, etc.).

The pupils should name, among the pieces of electrical equipment, the refrigerator, the lights, mixer, stove (if the pupils are accustomed to gas stoves only, they may not name this), clock, iron, toaster, vacuum cleaner.

Point out that the electrical equipment must be connected to the source of electrical power. Call attention to the cords and plugs. If the pupils point out that there are no wires for the lights, tell them that there are connections which do not show because they are covered by the fixtures themselves. Discuss the value of each electrical device shown.

The pupils should make the following generalization: Electricity gives us light and makes it possible to have many tools and machines in the home that save us time and work.

Extending and Enriching Activities:
1. Have the pupils list electrical equipment that they have seen.

2. Explain that electricity is bought, and show the pupils the school's electric meter.
3. Find out how household electrical equipment should be cared for to protect its life.
4. Discuss the value of electricity in community life: street lights, electric water pumps, electric streetcars, etc.

Page 27

Relation to the Unit: To present the advantages of electric-powered household machines; to promote the ability to compare and evaluate.

Concepts:

A. Electric machines help do work faster.

B. Electric machines do work with less effort.

Procedure: Have the pupils compare each pair of pictures, identify the electrical equipment, and decide what its advantages are over the contrasting non-electrical equipment. Have the pupils note the electric cord, and stress the fact that it is connected to the source of electric current. In the study of the first pair of pictures, stress the ease and speed of cleaning the rug. In the second pair, stress the speed and lack of muscular effort required. In the third pair, note the comparatively small amount of manual effort used in getting ice and stress other advantages of the electric refrigerator. After the pupils have discussed each pair of pictures, say, "Do you think your mother would like to have the machines on the left side of the page in her house or those on the right? Why?" Elicit that the machines on the left side would help get the work done faster, that using them would not make her tired, and that the vacuum and electric washer would probably do the work better.

During the discussion use such terms as *vacuum cleaner*, *washer*, *wringer*, *motor*, *cord*, *plug*, *current*.

Extending and Enriching Activities:

1. Bring an electric hand vacuum cleaner, a whisk broom or brush, a small piece of carpet, and some talcum powder into the classroom. Rub powder into the carpet and find out the amount of time needed to brush it out and the time required to remove it with the electric cleaner. Discuss the amount of labor needed for each job. (Be sure to use the same amount of powder each time.)
2. Make a survey of the electrical equipment at home. (In neighborhoods where there are widely different types of home backgrounds, it is better to omit this activity than to cause any embarrassment to the pupils.)
3. Make a survey of the electrical equipment in the school building — lights, stage lighting, movie projectors, radios, public-address system, clocks, bells, etc.
4. Make posters of electrical equipment with such appropriate headings as: *These make Mother's work easy*. *These give us a pleasant home, etc.*

Page 28

Relation to the Unit: To present in story form the idea that electrical equipment provides an efficient source of power.

Concepts:

A. Electrical devices must be turned on and off.

B. Electricity is ready for instant use.

Information for the Teacher: Children at this level accept without question the fact that electricity is turned on or off by moving a button, etc., in or out, or up or down. A technical discussion of how a switch works is not advised because an explanation of a socket or switch from model or diagram will be beyond the level of most six-year-olds. It is sufficient if pupils recognize that turning the switch off breaks the flow of electricity, whereas turning the switch on makes it possible for the current to "flow" into the light bulb or motor.

If some pupils point out that electric refrigerators, etc., do not have to be turned on, the teacher may explain that in some electrical equipment, such as refrigerators and telephones, the electricity is turned on and off more or less automatically once the machine is connected to the source of the current.

Teachers who wish to extend their own information on the control of electric current will find diagrams in *Discovering Our World*, Book 3,* on page 136.

Procedure: Develop the picture story as suggested for pages 4-5. As the pupils discuss Picture 4, ask, "What do you think will happen?" For Picture 5, ask, "Why did the man jump?" For the last picture, ask, "Why did the man look puzzled?"

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Such questions will help the children not only to enjoy the humor of the story but also to understand that turning on a switch makes it possible for current to flow into a light or motor and turning it off breaks the "flow."

Extending and Enriching Activities:

1. Bring to the classroom many types of equipment—toaster, radio, iron, electric lights, both pull-chain and switch types—and let children feel, see, or hear for themselves the effect of turning on and off the current.
2. Arrange extensions to light a playhouse, play store, or other project being developed by the class.

Page 29

Relation to the Unit: To provide an opportunity for the pupils to apply the concepts developed on the preceding page and to perceive likenesses and differences in electric and nonelectric equipment.

Procedure: Direct the children to look at the first pictures on the left and have the objects identified. Then read the title and say, "Must the egg beater be turned on before it will work? How about the mixer?" Then say, "In each box on the page, there are two machines or tools that are used for the same purpose." Guide the children in examining the pictures, naming the articles shown, telling in what way they are alike or different, and identifying the one which must be turned on in order to work.

Have them explain why in most situations the electrical equipment is better. For example, in Picture 1, both implements shown in the box are beaters and will beat eggs. One beater is operated by hand and requires muscular energy, while the other operates by electricity and requires no manual effort. Elicit that the electric beater makes the work of beating easier and faster.

Continue in this way with the remaining pictures, identifying the machine that must be turned on, and explaining how it differs from the other machine in the box in the amount of effort required to operate it.

Extending and Enriching Activity:

Bring electric trains and other electric toys to school and demonstrate how they work.

Page 30

Relation to the Unit: To demonstrate how the wheel as a simple machine makes work easier; to promote the ability to compare, contrast, and evaluate.

Concept: Wheels help us move things more easily.

Information for the Teacher: The wheel was one of man's greatest inventions. When objects must be dragged over a surface, the two surfaces rub together and there is a great deal of resistance, or what is commonly called "friction." A wheel reduces the extent of the rubbing surfaces. There is only the friction of the wheel around the axle and the friction of that portion of the wheel that touches the ground. Thus only a little force is required to overcome the friction.

Procedure: "Today we are going to see another way of making our work easier.

"Carrying things that do not weigh much is not hard work, is it? But carrying or moving things that are heavy can be very hard work indeed. Did your arms ever ache when you lifted or moved something heavy? Tell us about it." Elicit that when heavy things are lifted or moved, people's arms and legs may ache as a result of the strain.

Say: "Today we have two picture stories on the page. Look at page 30 and find them. Glance through the stories and tell us how they are alike." Elicit that they both have the same characters and that both stories begin in the same way: a storm is coming and the children need to get the toys safely put away before the rain begins to fall.

Develop the first picture story, and then say: "Now let us find out how the second picture story is different from the first. Would we begin the second story in the same way that we began the first story? Are the second pictures in each story alike? How are they different? How are the third pictures different? How are the fourth pictures different? In which story do you think the boys worked harder? What makes you think so? What helped the boys move the toys in the second story? How many of you have a wagon? Is a wagon a box on wheels?"

If the pupils have difficulty grasping this concept—and they may have, because most children consider a wagon a nondivisible unit—say, "Has anybody here ever made a wagon? How did you make it?" Elicit that the homemade wagon was

made by putting two pairs of wheels under a box. "If the boys in the first story had no wagon, they could have made one quite easily, since they already had the box. What would they have needed to make a wagon?" Elicit *wheels* and stress the wheels as the vital part.

Have the pupils name other things on which wheels are found. (Bicycles, skates, trucks, cars, etc.)

Retell the two stories and have the pupils decide which shows the easier way of moving the toys. In the narrative reiterate the importance of wheels. Stress the fact that, in using the wagon, the boys got their work done with little effort on their part and completed the work of moving the toys in a few minutes.

Extending and Enriching Activities:

1. Dramatize the stories. A wagon, a wooden box or crate, and a heavy load (books or blocks instead of toys) will be needed.
2. Draw or collect pictures showing wheels in use.
3. Make a survey at home or in the schoolroom of ways in which wheels help in doing work: lawn mower, wheelbarrow, wheels on vacuum cleaners and carpet sweepers, cars, furniture castors, clothesline fixtures, baby carriages, etc.
4. Make scooters with old skates.
5. Make small wagons at the workbench, using spools or skate wheels for wagon wheels.
6. Make a picture collection showing wheels used in various ways: automobile, wagon, roller skate, bicycle, castors, etc.

Page 31

Relation to the Unit: To demonstrate further the use of the wheel in making work easy; to provide opportunity for the application of the concept developed on page 30.

Procedure: Tell the children that the page has three parts and read the title. Then say, "Look at the first pair of pictures. What are you to find out?" (the picture that illustrates the easy way of getting the work done) As they identify the correct pictures on the page, they should describe the work being done and justify their answers. In the discussion develop the meanings of such words as *axle*, *castors*, etc.

Extending and Enriching Activity:

Duplicate in so far as possible the situations shown on page 31 and have the pupils determine experimentally "the easy way." A toy wagon and a toy wheelbarrow may be used, and any fairly heavy piece of furniture with removable castors can be substituted for the crib. Do not permit the pupils to lift one another or to move loads that are too heavy for them.

Page 32

Relation to the Unit: To highlight the importance of a machine as a time-saving device; to promote the ability to compare and evaluate.

Concepts:

A. Some machines help us do work rapidly.
B. Some machines help us do work easily and rapidly.

Information for the Teacher: In Picture 1 the saving lies in time rather than expenditure of muscular energy per unit of time, whereas in the remaining pictures there is saving in both time and effort.

Procedure: Read the question at the top of page 31, and have someone tell what the problem was on that page. Then read the title for page 32 and say, "What are we to find in each box on this page? Look at the first box. Which picture shows a way to get the work done faster? What makes the work go faster in this picture than in the other?" (The use of the machine is the determining factor in speeding up work in each case.)

After discussing the remaining boxes in the same way, say, "Why are machines valuable?" Elicit that some machines are valuable because they help people do work easily. Some machines help people do work rapidly. Some machines help people do work easily and rapidly.

Extending and Enriching Activities:

1. Duplicate the situations in Pictures 1 and 6 to demonstrate experimentally the superiority of the machine.
2. Picture 6 may be used to review the work on electrical household helpers, if this seems advisable.
3. Compare other work observable in community or school done with and without machines: corn pickers, wood-cutting by hand and power saw, electric floor waxer, mop wringer, window squeegee, etc.
4. Visit a local business—lumberyard, newspaper, etc.—to see how machines speed work.

Page 33

Relation to the Unit: To call attention to the fact that some machines have engines; to promote the ability to discriminate between machines powered by engines and those that are not.

Concepts:

A. Some machines have engines.

B. Machines with engines have greater power than most machines without engines.

Procedure: Ask, "How many pupils have bicycles? How do you make a bicycle go forward? When do you have to pedal very hard? (going uphill) Do your legs ever get tired after you have been riding a long time?

"Bicycles are fine to own because the wheels make it easy for us to get from place to place. Suppose we wanted a bicycle that we wouldn't have to pedal. What could we do? (*Put a motor on it, Put an engine on it, Get a motorcycle* are acceptable answers.) Yes, if we had engines or motors on our bicycles, we wouldn't have to work at pedaling, would we? The motors would give power to make the bicycle move.

"Many machines have engines in them. Today we are going to look at pictures of machines, some of them with engines."

Read the title aloud. Then ask, "Are both men using wagons? Can a wagon move itself? What is moving the red wagon? The green wagon? Does a tractor have an engine? Is the tractor with one engine pulling as much as the horses?"

After the pupils have identified the machines pictured below, have them select the pictures of the machines that have engines. Point out that the engine supplies power to make the automobile, airplane, ocean liner, and train move. In the discussion develop understanding of such terms as *power*, *engine*, *motor*, *load*, *tractor*, etc.

Have the pupils tell what power could be used to move the remaining objects pictured. (A boy pedalling could give power to the tricycle, a man could push the lawn mower, a horse could pull the wagon, etc.) Point to the train and say, "Could a man pull a train? Could horses pull the train? What can engines do that man or horses cannot?" (move heavy things)

To aid pupils in generalizing say, "A tricycle, a milk wagon, and a locomotive are all machines. Can a tricycle work itself? What gives it power to move?" Repeat for the milk wagon (horse) and locomotive (engine). Then ask, "Can the machine work itself? What things give power to these three machines?" Elicit that people can give power to machines. Animals can give power to machines. Engines can give power to machines. Then elicit that machines with engines can do work more easily for us and/or more rapidly.

Extending and Enriching Activities:

1. Observe various engine-driven machines and the work they do.
2. Make posters and pictures of machines with engines.
3. Find out how Father takes care of the engine of his car—regular check-up, regular checking and changing of oil, etc.

Pages 34-35

Relation to the Unit: To show how different machines and tools are valuable for doing certain things more easily and quickly.

Concepts:

A. Different machines do different things.

B. People choose and use machines for a particular purpose.

C. Machines with engines are used to do very heavy work.

Information for the Teacher: The special machines shown for heavy construction work are: Picture 1, steam shovel; Picture 2, truck, steam shovel; Picture 3, crane; Picture 4, crane; Picture 5, rivet-gun and bucking-bar; Picture 6, cement mixer.

Procedure: Discuss erecting buildings, and, if at all possible, visit a large building under construction to find out how machinery and tools assist the men in erecting the building. If it is not possible to make such a visit, talk about problems in building large structures—the strength required in the walls and floors, why steel is commonly used, why deep foundations must be made, etc.

Direct attention to the first picture. Ask, "What work is being done? How is it being done? Does the steam shovel have an engine? Will the man using the steam shovel dig the hole more quickly than the men could with their spades?"

For Picture 2 ask, "What work is the steam shovel doing now? Could the man using the steam

shovel fill the truck more quickly than the men with their wheelbarrows and spades?"

For Picture 3 say, "What work is being done? What do we call this machine? (crane or derrick) What is it lifting? Does the crane have an engine? Could the men lift the steel girder as easily and quickly as the crane does?"

For Picture 4 ask, "What is happening here? What has lifted the steel girder so that it can be put into the building? Could even many men using just their arms lift the girder as easily as the crane does it?

"What do you think is happening in the next picture?" If the pupils do not know, tell them that the men are fastening the steel girders together with rivets or bolts and that the man in the blue overalls is using a rivet-gun (a machine hammer).

For Picture 6 say, "What kinds of machines do you see in this picture? (wheelbarrow and cement mixer) Which machine has an engine? Could the men mix concrete as fast without that machine? Can a steam shovel be used to mix concrete? Can a wheelbarrow be used to fasten girders together?"

In this picture-by-picture examination and discussion encourage the children to use the correct names for the big machines.

To aid the children in making the generalizations that machines are designed to do certain things and that we select the machine that does the work easily and quickly, ask such questions as the following: "If your father wanted to plant a young tree would he choose a steam shovel to dig the hole? Which machines do you think the owner of a lumber yard would like to own? Why? Which machine would help the man who paves our streets?"

Extending and Enriching Activities:

1. If it has been possible to watch a building being erected, make pictures to illustrate steps in large-scale construction.
2. Find out how other large structures, such as bridges or roads, are built and how machinery is used in their construction.
3. Prepare an illustrated story about machines used in constructing a large building.
4. If possible, observe such construction workers as truck drivers, crane operators, steel men, sand hogs, riveters, etc. Make pictures of them working, and, if desired, add descriptive text.
5. Watch small buildings, e.g., homes, being built and contrast the machinery and labor used with that used in the construction of large buildings.

Pages 36-37

Relation to the Unit: To stress the need of intelligent use and selection of mechanical equipment; to provide a problem-solving situation.

Procedure: Have the pupils examine the pair of pictures at the top of page 36 and discuss the change that has occurred. Be sure the pupils understand that the room has been cleaned as well as straightened.

Read the question aloud and have the pupils select the tools and machines the woman probably would use in cleaning the room. The pupils should justify *both* their selections and their rejections. Discuss also the work done here without machines.

Follow the same procedure for page 37.

The pupils should understand clearly that many tools and machines are shown on these pages, but only those which help in the solution of the particular problem are of value to the worker.

Extending and Enriching Activities:

1. Examine the tools that were not used in solving these problems and decide how they could be used.
2. Make posters about tools: *Tools the carpenter uses*, *Tools for making a garden*, *Tools I used in building a birdhouse*, etc.
3. Make a list of one day's activities and tell what machines and tools were used. Classify the tools according to the power used, e.g., electrically operated tools, gasoline-motor tools, etc.

Page 38

Relation to the Unit: To stress the value of mechanical equipment in daily life; to promote ability to reconstruct and visualize accurately.

Procedure: Have the pupils examine and discuss each picture, talk about their gardens, etc.

Say: "Making a garden means a great deal of work. Who do you suppose made this garden? The people would have had to work much harder and far longer if they had not had tools to help them, wouldn't they? What tools and machines do you think they used to make this garden and to help it grow? Before you answer, think of the tools your father uses in making and caring for the garden."

Probably all pupils can list such equipment as a hoe, rake, spade, and hose. Many pupils will add

such things as plows, cultivators, scissors, insecticides, spray guns, etc. If a pupil mentions seeds, explain that while seeds are needed for a garden, they are not tools or machines.

In introducing the second picture, say: "This is a fine playhouse, isn't it? It looks strong and well built. Do you like the color it has been painted?

"Father built the playhouse for the children. What tools do you think Father used?" (If a pupil mentions a *broom*, explain that while it is a tool, it would not be used in the construction of the house. Ask for what work in the playhouse the broom would be used.)

Extending and Enriching Activities:

1. Make posters of groups of machines and tools used for common purposes, such as making a garden, building a doll house, changing a tire, making a scooter, etc.
2. Find out how tools and machines should be cared for: oiling, protection of cutting edges, protection against rain, etc.
3. Check the tools at the schoolroom workbench.
4. Formulate safety rules for using tools at home and at school.
5. Visit a small factory or repair shop to find out what machines and tools are used, what the safety rules are, how the machinery is kept in good working order.
6. Keep a diary of one day's activities to show what machines, tools, engines, and electrical equipment have been used.

Upon Completion of the Unit

The class may be organized into committees, each committee reporting to the class on one of the following topics. (The topics may, of course, be changed to meet local situations or interests of the pupils.) On the report pupils should use the posters and booklets made during the progress of the unit.

1. How to Care for Tools
2. Machines and Tools Used at Home
3. Machines and Tools Used at School
4. How Electricity Is Used in School
5. Machines and Tools Used in Building a House
6. Machines and Tools Used in Road Construction

UNIT 3 Days and Days

General Concepts

A. There are many kinds of weather.
B. Seasons have characteristic weather conditions.
C. People adjust their activities and clothing to changes in weather and season.

(For a more detailed outline, see the Index to Concepts, pages 70-72 of *Look and Learn*.)

Page 39

Relation to the Unit: To introduce the main concepts of the unit; to provide an example of one common type of weather; to promote the habit of careful observation and of making deductions on the basis of these observations.

Information for the Teacher: At this grade level the work on weather conditions and combinations should begin with actual observation. For this reason, the lessons in Unit 3 have been so constructed that they may be presented, within certain limits, in varying order without retarding growth in understanding. The unit as a whole may be analyzed as follows:

Page 39 (unit-picture page) presents sunny, warm weather.
Pages 40-41 present rainy weather.
Page 42 deals with snow and cold weather.
Page 43 is a summarizing page to be presented when pages 39-42 have been completed.
Pages 44-47 involve common types of weather as a whole.
Pages 48-49 and 50-51 present weather conditions characteristic of the seasons.
Page 52 summarizes the concepts presented in the unit.

Procedure: Read and discuss the title. Suggest that the title indicates that the unit will tell about various kinds of days.

As the pupils discuss the picture, ask what kind of day is shown. If a pupil replies merely that it is a nice day, lead him to discuss the sunshine; whether the day is cold, warm, or hot; whether it is a day in summer or winter; whether the wind is blowing, etc. The pupils should justify their comments by citing evidence from the picture.

The pupils in justifying their answers may say they know that the day is hot because the boy is barefoot and without a shirt, and the cows are resting in the shade; that it is a summer day because the grain is ripe, because the boy is dressed for summer, because the trees are in full, heavy foliage; that there is no wind because the grain stands erect, the leaves and plants are obviously still.

From the pupils' contribution to the discussion, the teacher should be able to estimate quite accurately the progress they are making in observing carefully, and making deductions from observed data. The pupils should understand and use such words as *weather, heat, sun, sunshine, clouds, summer, wind, shade.*

Extending and Enriching Activities:

1. Have the pupils compare the day portrayed with actual weather conditions at the time the picture is discussed. Discuss similarities and differences.
2. Tell about other things the child in the picture could do on a fine day such as that shown in the picture: have a picnic, help his father, dig in the garden, etc.

Page 40

Relation to the Unit: To present in story form additional weather combinations and their effect upon human activities.

Concepts:

A. Sun, rain, and wind are elements of weather.
B. Weather changes often.
C. People adjust their activities to weather conditions.

Information for the Teacher: If possible get a photograph of white cumulus clouds to contrast with the rain clouds in Picture 3. (See Bibliography, pages 164-172, for books containing cloud pictures.)

Procedure: "Did you ever get caught out in the rain without your raincoat and umbrella? Tell us about it. Our story today is about some people who got caught in a rainstorm." Read the title and develop the story as suggested for pages 4-5. Guide the discussion so that pupils use meaningfully such words as *cloud, storm, rain, weather, wind, sunlight.*

Then say: "Look at Picture 1 again and tell all you can about the weather. (Sunny, warm, probably summer.) Look at the clouds in Picture 3. They are often called 'rain clouds.' How would you describe them? These clouds (show picture of white cumulus clouds) are not rain clouds. We often see clouds like these on bright summer days. How are these clouds different from the rain clouds in Picture 3?

"Look at the story again and decide in which picture you were almost sure that it would rain (Picture 3). Tell what helped you to decide." To elicit that clouds often tell us about weather changes, ask, "What can we sometimes tell from looking at the clouds?"

Extending and Enriching Activities:

1. Study the clouds over a period of several days so that various types can be observed. It is not necessary to teach the pupils the names of typical cloud formations.
2. Make pictures of cloud formations and add appropriate titles, such as, *These clouds were in the sky Wednesday. It rained soon,* etc.
3. Tell stories of humorous adventures resulting from sudden weather changes.
4. Draw or cut from magazines pictures about proper clothing for rainy and sunny weather conditions.
5. Make picture riddles or tell riddles about weather.
6. Have pupils tell how they would change the picture on page 39 to show a rainy day in summer.
7. Read to the children weather jingles, such as "One Misty, Moisty Morning," "Rain, Rain Go Away," and the poem "Rain" by Robert Louis Stevenson.

Page 41

Relation to the Unit: To indicate additional factors to be considered when predicting weather changes; to develop ability to predict results from observed conditions.

Concept: Weather can be predicted.

Information for the Teacher: The light from the sun is made up of all colors of the rainbow. Each color has its own wave length. When light from the sun strikes a drop of rain, the seven different colors of sunlight are bent differently and are reflected at different angles. Each drop reflects all seven colors, but we see only one color from each drop depending upon the angle from which we see it. The other colors come from different drops that are observed from different angles.

Procedure: Call attention to the rainbow in the big picture and tell the children that we never see a rainbow unless the sun is shining at the same time that it is raining or misting. Tell them also that the colors of the rainbow are made by the sun as its rays strike the drops of water.

Then say, "Has it rained recently? How do you know? (puddles) Do you think that the sun will come out soon? Why? (clouds are breaking up, faint yellow light on the road, rainbow) Now look at the little pictures at the right. Find the little picture that shows the kind of weather you would expect to find soon after you see a rainbow. What kind of weather is it? (sunny)

"Look at the other big picture. What is happening? (black clouds, lightning, strong wind) Find the little picture that shows the kind of weather you think will follow very soon. What kind of weather is it?" (rainy weather)

In the discussion stress such words as *lightning, rainbow, rain, clouds, puddle, wind,* etc.

Extending and Enriching Activities:

1. Make weather predictions from morning to afternoon and from day to day. Check these predictions with the subsequent weather.
2. Read weather predictions in the local newspaper to the class and have pupils check their accuracy.
3. Find out how weather reports and predictions are important to farming, shipping, airplane flights, boat sailings, etc.
4. Discuss the effect of weather on the plans of members of the class (planning a picnic, etc.).
5. Measure the amounts of rainfall on the various rainy days. Use a straight-sided can or glass jar placed in an open spot.
6. Observe local storms, such as hailstorms, sleet or ice storms, thunderstorms, windstorms, etc. Note the weather combinations immediately preceding them.

Page 42

Relation to the Unit: To present snow and cold as elements of weather; to give practice in noting cause-effect relationships.

Concepts:

A. Rain falls as snow in cold weather.

B. Dark clouds may indicate snow in cold weather.

C. People adjust their activities and clothing to changes in temperature.

Procedure: Discuss the fun the pupils have had in the snow, the games they played, etc. In order to elicit that the weather is usually cold when we have snow, ask, "When you play outdoors in the snow what kind of clothes do you wear? Why?" If the pupils live in an area where snow seldom falls, lead them to infer that the reason for the lack of snow is the moderate temperature during the winter months.

Have the pupils examine and discuss the pictures. Make sure that they note the dark sky, the lights in the house, the falling snow, the deep drifts, and the work and dress of the people in Picture 1. In Picture 2, note that the sky is lighter, that the sunlight makes the colors look different. Note the melting snow in Picture 3 and discuss the change in temperature which caused it. Compare the three pictures and note details that show why there is a time interval between the pictures.

Extending and Enriching Activities:

1. Name the games and sports that are confined to winter weather: ice skating on ponds or lakes, coasting, etc.
2. List important cold-weather chores, such as cleaning snow from the walks and roads, heating the house, collecting eggs before they freeze, bringing in milk before it freezes, taking care of the stock, etc.
3. Compare the clothing of the children on page 42 with the clothing of the children on page 38.
4. Compare the picture on page 42 with the chapter title picture on page 39.
5. Draw, or cut from magazines, pictures of clothing suitable for various weather combinations.
6. If this lesson is studied when there is snow on the ground, melt snow on a stove or at room temperature and demonstrate that snow is changed to water by heat.

Page 43

Relation to the Unit: To promote ability to make inferences and simple generalizations from given data.

Procedure: Explain to the pupils that there are three pairs of pictures on the page. Direct the pupils to look at the first pair of pictures carefully, noticing especially the weather conditions shown. Ask, "How is the second picture different from the first? What has happened? If you were drawing a picture of what happened, what kind of weather would you show?" The pupils should justify their answers.

Continue in the same way with the other two pairs of pictures.

If the pupils give answers similar to the following, they are making satisfactory generalizations:

1. We should draw a picture of a rainstorm. The sidewalks are wet in the second picture, and so it has rained. It couldn't have been a sleet or ice storm because this is a warm day. The clothing of the people tells us that it is a hot summer day.
2. We should draw a picture of a snowstorm.There is snow in the first picture, but we can tell that more snow has fallen. Look at the sidewalks, the snow man's hat, the trees, the roofs, etc.
3. We should draw a picture of a windstorm, quite a strong windstorm, too. The washing has been pulled around, and some of it is on the ground. It takes a strong wind to do that; a little breeze wouldn't. The pile of leaves has been scattered by the wind, too, and many of the leaves have been blown from the trees.

Extending and Enriching Activities:

1. Draw pictures to illustrate what happened in the time that elapsed between each pair of pictures shown on page 43.
2. Draw pictures or cut out magazine pictures for additional exercises of the type introduced on page 43.

Pages 44-45

Relation to the Unit: To further extend the idea that there are many different weather combinations.

Information for the Teacher: The types of rainy days shown are: rainy summer day to be followed soon by clear weather; heavy rainstorm in fall or winter, accompanied by strong winds and lightning; light rain in spring, no wind.

The sunny-day combinations are: crisp, still, cold, sunny winter day; cool, still, autumn day; hot, windy day in summer.

The types of windy days shown are: warm, windy day in summer; cold, windy day in winter; extremely cold winter day of blizzard proportions.

The cloudy-day combinations are: cloudy, cool, windy day in autumn, probably to be followed by rain; cloudy, cold, winter day, probably to be followed by more snow; bright, windy, summer day, clouds not indicative of rain.

Procedure: Read aloud the heading for the first column of pictures and point out that all the pictures in the column show some type of rainy day.

"Who would like to tell us about the weather in the first picture? Is it raining hard now? Why do you say so? (child playing outdoors) Is it a windy day? How do you know? (rain coming straight down—trees not bent) Is it a warm day? Why? (sun suit) Do you think the sun will come out soon? Why?" (rainbow)

Follow the same procedure for the pictures in the other columns. Have the pupils examine each picture in the column and describe it. Next, have pupils tell how each picture is alike or different from each of the other pictures in the terms of temperature, wind, and cloud formations.

In Picture 2 the pupils should note the black clouds, the lightning (recall the lightning on page 41), and the clothing of the child. The pupils should infer that this rain is probably falling during an autumn or winter day, since there are no leaves on the trees and the plants are dark in color. The pupils should also infer a strong wind because of the angle of the raindrops and the position of the boy's body.

In the third picture the pupils should conclude that this is a rainy day in spring and note the absence of wind.

Follow the same procedure for the sunny, windy, and cloudy days shown, and have the pupils find the picture that most closely approximates the weather observed on the day during which the work is undertaken.

The findings of the two pages should be carefully summarized so that the teacher may be sure the pupils understand the concepts presented.

Summaries should involve reëxamination of the pictures and should point up the generalization that there is an infinite number of different weather combinations.

The pupils should make the following generalizations: There are many combinations of elements that make weather. To describe weather, it is necessary to tell about temperature, wind, and the sky (whether it is fair or cloudy, raining or snowing). Describing only one element of weather does not give a true weather picture. The pupils should also make the generalization that there are many types of weather during any one season. The things we do and the way we dress are influenced by the weather.

Pages 46-47

Relation to the Unit: To suggest weather recording by observation and use of simple symbols.

Concept: Weather varies from day to day within a month.

Information for the Teacher: The teacher will need a large calendar having sufficient room for weather notations. If this is not available, sheets of oak tag or newsprint may be ruled and numbered as shown on page 47 for the particular month during which the lesson is studied.

Procedure: Introduce the pages as follows: "What do you think the children in the pictures on page 46 are doing?" (making a weather chart or weather story so that they will know what the weather is from day to day) Read the caption and then ask, "How does knowing about weather help us? Where can we find out what the weather will be tonight? (newspaper, television, and radio weather reports and predictions)

"If we did not have a newspaper, a television set, or a radio and wanted to guess what the weather would be in the next few hours, what could we do? (observe clouds, sun, wind, etc.)

"Look at each picture carefully. Do you notice the window in the pictures? Pretend that you are one of the children in the picture. Look out the

picture window and decide what kind of day it is. What is the girl in front of the class doing? Yes, she is hanging up a weather chart to show what kind of day it is. Do you think the picture on the chart describes the day correctly?"

Proceed with the remaining pictures on page 46. The teacher may ask what else could be placed under each picture on the weather chart (a sentence about the weather).

Say: "Perhaps it would be interesting for us to keep a record of the weather, as the children in the pictures are doing.

"The picture on page 47 shows the kind of weather chart we might make. This is a page from a big calendar. We have one here (pointing to the calendar on the wall) that is very much like the one in the book. Look at the one in the book again. It is called 'Our Weather Chart' (show title). Under the title we find the name of the month. The name of the month during which this chart was made is March. What is the name of this month? Yes, here it is on our calendar." (If the pupils have had little experience with calendars, the teacher should explain how they are constructed—the months of the year, the days of the week, the rotation of days of the week—and how to tell on what day a specific date falls, etc.)

"The weather chart in *Look and Learn* tells us that the first day of March was Monday. What kind of day was the first day of March? What kind of day was the second of March? That is the same kind of day we saw in the first picture on page 46, isn't it?" (Continue in detail with the first five days, showing that they correspond with the weather conditions portrayed on page 46.)

"We usually have all kinds of weather in the month of March, for March is the month at the end of winter and the beginning of spring. Some days are cold and snowy, some days are rainy, some days the sun shines, and some days are cloudy. Are there any rainy Sundays shown on the weather chart for March?

"On Saturdays children like to play outdoors. Were there any Saturdays when the children could not play outdoors?

"Find a Friday that would have been a good one for Mother to go shopping. Find a Tuesday when you could have used your sled. Find three days when you could have used your roller skates. Find three days when you would have needed to wear your snowsuit.

"Let us find out how many sunny days there were in March. How many rainy days were there? How many snowy days were there? How many cloudy days? How would you describe March weather?"

Encourage the pupils to make a weather chart similar to the one shown, although the symbols may differ and the pupils may wish to include on the chart information regarding wind and temperature.

Extending and Enriching Activities:

1. Prepare a weekly summary of weather conditions for the class bulletin board. Statements indicating the influence of weather upon the activities of the pupils may be added.
2. To demonstrate that the amount of rainfall varies, measure the amount of rainfall during several twenty-four-hour periods. Use a straight-sided, open-mouthed tin can or glass jar. Leave it in an unsheltered spot and, after a rain, measure the height of water with a ruler. These amounts may be recorded for several rainy days.
3. Describe unusual local weather conditions, such as windstorms, hailstorms, ice or sleet storms, etc.

Pages 48-49

Relation to the Unit: To develop the concept of seasons and their order.

Concepts:

A. The seasons are spring, summer, autumn, winter.
B. The seasons always follow each other in order.
C. Seasons have characteristic weather conditions.

Information for the Teacher: On pages 48 and 49 the seasons are presented as periods during which characteristic weather conditions may usually be expected. The pupils should be aware of the fact that weather varies within a season, but they should see that certain weather conditions predominate in any specific season. Too detailed work on the seasons is not advised, and no attempt should be made at this level to explain causes of seasons.

The weather conditions shown are those normally expected in the north temperate zone. Where local conditions require, the teacher should adjust her teaching procedure.

Procedure: While the method of introduction depends to a large extent upon the pupils' background of experience, the pages may be introduced as follows:

"Look at the four pictures on pages 48 and 49." Is each one a picture of the same farm? How can you tell? Does the farm look the same in each picture? Let's look at them carefully and see in how many ways they are different.

"Look at the trees in the first picture. What is happening to them? At what time of year does this happen? Could the farmer plant his seeds today? What has happened since he did his plowing? (rained) When will he be able to plant the garden?" (after the sun dries out the soil)

"Look at the second picture. See the corn! When does corn look like this? What has happened to the trees? What season is it?" (Proceed in the same way with the remaining pictures.)

"We have seen the garden and the trees and the fields in spring, summer, autumn, and winter. What season comes after winter? What will happen to the trees in the spring? To the flowers?" (Leaves will come out on the trees and the spring flowers will bloom again as they are shown to be blooming in Picture 1.)

"How many of you have gardens at home? Which picture most nearly shows how your yard looks now? What season is it now—spring, summer, autumn, or winter? What will be the next season? How will your garden look then? Find the picture that shows you."

Stress the fact that the seasons follow one another in order. When this is fully understood, develop concepts of characteristic weather conditions of each season. Recall the weather chart and tell the pupils in what season the month falls. Have them analyze the chart to determine the type of weather that predominated. The pupils should reëxamine pages 39, 40-41, 42, 43, and 44-45 to find characteristic weather conditions of the seasons. Have them recall their own activities during the seasons. From these data they should formulate generalizations similar to the following:

In spring the weather begins to get warm. The snow melts, and there are many rainy days. The sun shines, too. Flowers begin to grow.

In summer we have hot weather. The sun shines and there are not so many rainy days as in spring. If we are near an ocean or a lake, we go to the beach in summer. The gardens grow, and we pick flowers and vegetables.

In fall or autumn the weather begins to get cooler. Some plants die. There are not so many flowers. Darkness comes earlier, and we wear warmer clothes than in summer.

In winter the weather is often cold. Some days are sunny. Sometimes we have snow. It is dark when we go to bed and still dark when we get up. The wind is cold.

(The teacher should be careful to avoid giving the impression that there is only one kind of weather for each season. This error is probably best avoided (1) by analyzing the weather chart as suggested, (2) by recalling various kinds of weather during other seasons, and (3) by reëxamining pages 44-45 to find all pictures for a given season and the different weather combinations for that season.)

Extending and Enriching Activities:

1. Draw pictures of the school garden or home garden during each of the seasons. Label.
2. Mount on the bulletin board—spring, summer, winter, and fall pictures showing different weather combinations.
3. Draw or collect pictures to show seasonal activities, such as planting, harvesting, canning, etc.
4. Draw or collect pictures to show the kinds of clothing most often worn during each season.

Pages 50-51

Relation to the Unit: To provide experience in associating activities with characteristic weather conditions of the seasons.

Procedure: Discuss the four pictures at the top of pages 50-51 and compare them with those on pages 48-49. Recall the names of the seasons, pointing out the words. Discuss the kinds of weather usually found in each season.

Say: "The people and things we see across the bottom of the page could be placed in one or more of the big pictures. Look at the pictures at the bottom of the pages. Let's decide where each belongs. The first one shows a child in a sun suit. In what kind of weather would a child wear a sun suit outdoors? When do we have the warmest days? Then in what picture would you put the child?" (Proceed in the same way with each of the small pictures.)

Note that some of the subject matter of the small pictures, such as the child wearing a sweater and the farmer plowing, may be placed in more than one season. Call attention to these pictures

so that the pupils will understand that weather varies within a season as well as from season to season. (Teachers in localities outside the temperate zone will need to make suitable adaptations.)

Extending and Enriching Activities:

1. Make pictures or murals to show seasonal activities. Appropriate texts may be added, such as *Games We Play in Winter*, *Spring Flowers and Vegetables*, etc.
2. Re-draw the large pictures on pages 50-51 and add some of the people and activities shown in the small pictures.
3. Tell stories about the seasons and the holidays of each season.
4. Dramatize or tell riddles about seasons.

Page 52

Relation to the Unit: To summarize the unit.

Procedure: The pupils should be given opportunity to enjoy these pictures, and little formal introduction is needed. The pupils are to find the "silly" part of each picture and tell why it is silly.

They might indicate another picture in which the "silly" part would correctly fit—for example, the man strolling unconcernedly through the rain could be put in Picture 3.

The pupils might reëxamine each picture and tell what season is portrayed, whether it is cold or warm, what kind of weather is shown, how the people are attired, etc. In this way the main points of the unit may be successfully summarized.

Upon Completion of the Unit

The pupils may reëxamine the pictures in Unit 3 and discuss ways in which weather is an important factor in life. "Movies," posters, and booklets may be made, stressing the importance of weather predictions to farmers, airplane pilots, fruit growers, nurserymen, etc.

UNIT 4 Outdoors

General Concepts

A. There are many kinds of plants.
B. Plants grow and reproduce their kind.
C. People and animals use plants in various ways.

(For a more detailed outline see the Index to Concepts, pages 70-72 of *Look and Learn.*)

Page 53

Relation to the Unit: To introduce the unit; to indicate many kinds and uses of plants.

Procedure: Read the title aloud. Discuss the picture, and suggest that this part of the book will deal with many kinds of plants, some of which grow in our own yards. Ask the pupils to point to and name as many different plants as they can. Then say, "Tell me in what way the tree is different from the bush (size); the corn, from the grass (size); the cabbage from the corn." (shape of the leaves) Then say, "Why do you suppose the people who own this home planted trees in their yard? (shade, beauty) Why did they plant bushes, grass, and flowers? (beauty) Why did they plant vegetables?" (food)

The pupils should tell about their own gardens or the school garden, naming other plants they have at home. If the local season is not that portrayed in the picture, turn back to pages 48-49 and find the picture that most closely approximates local gardens in the current season.

Extending and Enriching Activities:

1. Draw pictures of home gardens.
2. Collect pictures or specimens of flowers that grow in home gardens.
3. List the names of flowers in the school garden, or plan a school flower garden.
4. Collect pictures of common plants—shrubs, vines, trees, and vegetables. Mount each picture separately and use for various purposes as the work progresses. Seed catalogues furnish much suitable material.

Page 54

Relation to the Unit: To introduce common ways of distinguishing between flower plants; to develop skill in comparing, contrasting, and classifying.

Concept: Flower color, size, and shape are ways of telling one plant from another.

Information for the Teacher: The names of plants in each row reading from left to right are: black-eyed Susan, field daisy, painted daisy, tea rose; yellow tulip, poinsettia, bronze tulip, parrot tulip; common blue iris, wild blue iris, yellow rugosa rose, Japanese iris, red and yellow iris; dandelion (blossom and seeds), tiger lily, Easter lily, lemon or day lily, pink spotted lily.

The teacher should, if it is at all possible, bring into the classroom some of the flowers pictured in the lesson. Differentiation of the actual flowers should be made in approximately the same way as differentiation is made in the lesson.

Stress the fact that the flowers pictured were parts of living plants. The pupils should perceive the general similarity of structure among the varicolored daisies, tulips, iris, and lilies despite differences in color.

The teacher may review page 9, making the generalization that despite differences in color, marking, size, etc., the fish in Row 1 are more like each other than they are like the snake, etc. Pupils should note that, in much the same way, while the flowers on page 54 may differ in color, marking, details of shape, etc., several in each row are more like one another than like the "odd" one. In this way, the pupils will begin to grasp important principles of classification.

The pupils should if the flowers are common to the environment name the flowers shown, although it is not necessary for them to know the names of the varieties—*daisy, rose; tulip, poinsettia; iris, rose; lily, dandelion* constitute sufficient identification.

Procedure: "The flowers on this page were a part of something. What was it? (plant) Look at

the flowers in the first row. What is the name of the first one? (If pupils do not know, tell them—daisy) The second one? Is the second flower like the first? How is it different? How is it like the first flower?" Follow the same procedure with third and fourth flowers. Then say "Which flowers are pink? Which flowers are white? Which flowers are daisies? Are all daisies the same color? What things are alike about all the daisies?" Follow the same procedure with the other rows. The pupils should use understandingly such words as *petals*, *flowers*, *leaves*, *shape*, *stem* and the names of the plants pictured.

Too detailed analysis is not recommended at this level, particularly with children of relatively small experiential background in this area. (The teacher may be surprised at the narrowness of the pupils' scope of knowledge in this area.) If too detailed analysis is attempted, the pupils may develop erroneous concepts

Extending and Enriching Activities:

1. Have the pupils tell about other flowers they have seen in their houses or gardens. As pupils describe flowers, lead them to do so not only in terms of size, color, etc., but also in terms of beauty of shape and scent.
2. Make an excursion in the neighborhood and see how many different flowers can be found.
3. Bring into the classroom for actual examination as many flowers as possible.
4. Make picture collections of garden favorites. Discuss similarities and differences in color, size, and shape of flowers, leaves, and plants in general.
5. Using the picture collection, continue the work on plant classification. Flowers may be classified as to similarity of color, size, shape of leaf, etc.

Page 55

Relation to the Unit: To present ways of distinguishing between different kinds of plants.

Concepts:

A. There are many kinds of plants.
B. The general contour of the plant and its growing habits are ways of distinguishing one plant from another.

Information for the Teacher: The three plants that are alike in the first row are grasses, in the second row shrubs, in the third row vines, and the last row trees.

The names of the plants in each row reading from left to right are corn, flowering almond, wheat, barley; lilac, tulip, bridal wreath or spirea, barberry; morning-glory, ivy, grapevine, evergreen tree (blue spruce); apple tree, palm, larkspur, weeping willow. Pupils should not be required to identify the plants, but they should name those that they know.

Procedure: Ask, "Is a vine a plant? Is a shrub a plant? Is a tree a plant? Is grass a plant? How do you know a tree when you see one? (big, one big trunk; leaves, branches, etc.) How would you know a vine when you saw one? (one stem; climbs; limber, etc.) How do you know a shrub when you see one? (low, many stems, leaves close to ground, etc.) Would you know a grass plant if you saw it? How does it look?" (If possible at this point, go to the window or out on the playground and find examples of these plants and note similarities in the trees, in the shrubs, in the vines, and in the grass if more than one variety is available.)

Then say, "Look at the plants in the first row. Which three look most alike? (1-3-4) Why? (single stem, long leaves, similar seeds) Look at the plants in the next row. Which three look most alike? (1-3-4) Why? (many stems, same general shape) Which plants in the next row look most alike? (1-2-3) Why? (climbing-stem requires support) Which three plants are most alike in the last row? (1-2-4) Why?" (single woody stem or trunk)

Extending and Enriching Activities:

1. Observe tree branches which have been forced, noting essential similarities and differences. (See Appendix, page 159.)
2. Observe grass seed which has sprouted and compare with other plants in the schoolroom or school garden.
3. Compare the stems of bushes, such as lilac or forsythia, with the stems of flower plants, such as tulips, iris, violets, or other available flowering plants.
4. Call attention to the skeletal shapes of various trees when they are not in full leaf.
5. Observe available vines: squash, pumpkin, melon, and other ground creepers; ivy, morning-glories, etc.
6. Find out how various common local vines climb. English ivy produces adventitious roots on one side of the stem; grapes and peas produce ten-

drils; Boston ivy supports itself by "suction" disks at the ends of tendrils; the stems of morning-glories twine about a support, etc.

Page 56

Relation to the Unit: To stress the fact that plants and animals are alive.

Concept:

A. Plants are different from animals though both are alive.

Information for the Teacher: Pupils at this level are too immature to grasp consciously the full definition and concept of aliveness. However, they understand many qualities of aliveness without being able to analyze them. Consequently, in developing the concepts of such words as *alive, living, living thing,* the teacher should avoid forced definitions and accept the evidence of the child's understanding of the general meanings.

Procedure: Read the title and say, "Everything on this page is a picture of a living thing. Look at the first row of pictures. How many pictures of plants do you see? What else do you see? Is it alive? Why do you think we say that plants are alive?"

Proceed in the same way with the remainder of the page.

The pupils should, if possible, identify the living things: hyacinths, cocker spaniel (or dog), jonquils (or narcissi), tulips; sunflower, lobelia, chicken (hen), tomatoes; hollyhocks, poppies, snake, ageratum, petunia; peonies, water lilies, tree, flamingo. However, the teacher should give prompt help when needed, and it should be kept in mind that specific identification is not the purpose of this lesson. (Flowers, dog, chicken, bird, tree, are sufficient identification.)

The pupils understand that the dog, the chicken, the snake, the flamingo are animals and that animals are alive. They should realize that the hyacinths, jonquils, tulips, etc., are plants and that plants are alive. Plants and animals are living things.

In the discussion, some work may be done on ways in which plants and animals are alike (both are alive, both grow) and ways in which they are different (different structures, animals' ability to move, etc.). Too detailed work should not be undertaken at this time, however. The essential purpose is active recognition of plants and animals as living things as opposed to such inanimate objects as stones, chairs, etc.

Extending and Enriching Activities:

1. Reëxamine pages 54-56 and decide how plants can best be distinguished from one another; color of flowers, number and shape of petals, shape of leaves, contour of plant, etc. Recall statements formulated on ways of discriminating between animals.
2. Make picture books or posters of plants grouped on the basis of factors listed above.
3. Compose riddles about plants and tell or dramatize them.
4. Combine the picture collections of plants and animals and make a game of classifying them according to whether they are plants or animals.

Page 57

Relation to the Unit: To extend understanding of plant structure.

Concept: Most plants that we know have roots, leaves, stems, branches, and flowers.

Procedure: Introduce the story by bringing a new geranium plant to the classroom and tell the children that the next page in their book will be a story about a naughty kitten and a geranium plant. Develop the story as suggested for pages 4-5 (the plant will be used in the reëxamination of the pages).

When the pupils have enjoyed the story about the naughty kitten, say, "Why do you think the geranium plant was on the window sill in the first place?" Elicit that most flowering plants need light. "Look at the first picture. Where is the flower in the picture of the geranium plant? The leaves? The stems?" Then hold up the real plant and say, "Where is the flower on our plant? The bud? The leaves? The stems?" The pupils should be encouraged to note the main stem, and the small stems connecting the leaves to the larger stems.

"Look at the second picture. Now that the flowerpot is broken, we can see another part of the geranium. Tell us what that part is. Why didn't we see the roots before?" Elicit that the roots of most plants grow in the ground. "Let's see if our geranium has roots, too." Invert plant, support it with spread fingers, rap pot sharply

with flat of ruler, spoon, or similar object. The plant will come out without danger to the plant. The pupils will be able to see parts of the roots without disturbing the soil, and to note the function of the roots in holding the plant upright in the ground. (The teacher may mention other functions of the roots, but the process by which plants make their food should not be discussed at this level.)

"How are the mother and the girl fixing up the damage the kitten did? Do you think the geranium will have another flower?" (If there is a flower bud on the class geranium plant, say, "Are we going to have another flower on our geranium soon? How do you know?")"The little girl and her mother will have to wait longer than we do for a new flower. Why?" Elicit that they must wait for a flower bud to develop.

Extending and Enriching Activities:

1. Draw a simple outline of a plant on the blackboard and label its parts.
2. Picture 5 may be used to stimulate interest in the needs of plants for successful growth: warmth, sunshine, and water. (See Appendix, page 159.) Over a period of two weeks, give one pot of bean plants water, warmth, and sunlight. Omit one of the essentials from other bean plants. Records should be kept of the condition of the plants.
3. Have the pupils re-pot the geranium plant. (See Appendix for care of classroom plants.)

Pages 58-59

Relation to the Unit: To demonstrate the life cycle in plants.

Concepts:

A. Many plants grow from seed.
B. Seeds produce the same kinds of plants as the parent plants.
C. Plants follow a definite pattern of growth.
D. Some plants live only a year.

Information for the Teacher: The annual (a plant that completes its life cycle in one year) used in this sequence, the larkspur, is both prolific and hardy. It will assist the children materially if some form of larkspur is shown to them during the lesson. Every effort should be made to bring in larkspur seed. Some of these can be sprouted in wet sand (do not plant too deep—$\frac{1}{8}$" is deep enough), but the seedlings cannot be expected to mature and blossom out of season under most circumstances. If the school has a greenhouse or conservatory, a flat of larkspur can be planted. Special greenhouse "forcing" seed should be obtained, and it should be remembered that forced plants take a long period to mature.

Before the lesson is presented, soak beans or peas overnight. (See Appendix, page 158.) Show the pupils the seed structure, pointing out the minute plant and the food for the baby plant. (See Appendix, page 158.)

Demonstrate that the roots of the plants always grow downward. (See Appendix, page 158.)

Procedure: Develop the picture story, using questions similar to the following: "In Picture 1, where do you think the little girl got the seeds? What time of year do we plant seeds? (spring) What will she do to the soil before she plants them? What do you think will make the seeds grow? In Picture 2, what has happened to the seeds? (sprouted) Do you know what we call a very young plant like this? It is called a seedling. Can you see the main stem of the seedling? In Picture 3, what has happened to the seedling? In what ways is the full-grown plant different from the seedling? (height, number of leaves, thickness of main stem) What else do you see besides leaves? (buds) The name of the plant in the picture is *larkspur*. In Picture 4, what has happened to the buds? Are flowers on every plant the same color? Are all the flowers the same shape? Are all the plants larkspur plants? In Picture 5, what has happened to some of the flowers?" (petals fallen; seed pods forming) The seed pods will stay on the plant until they are ripe (brown and dry). In Picture 6, use a magnifying glass to show the children how it enlarges so that they will understand the picture. "Are the seed pods in this picture the same color as some of the pods in Picture 5? What has happened? What is happening to the seed pod under the magnifying glass?" Tell the pupils that the seed pods of the larkspur are held erect. Explain that the pod shown in the magnifying glass might have been broken by a passing animal or person since the stems are dry and brittle. There are several ways in which the seeds might cast about: the movement of a passing animal or person, the action of a strong wind, etc. In Picture 7, ask, "What has happened to the larkspur plants? What do you think has happened to the seeds? (fallen to the ground in a relatively small area) Will the seeds sprout in this kind of weather? Why not? Do you

think they will come up in the spring?" In Picture 8, ask the pupils if there is another picture that shows the larkspur plants when they were about this size. "What time of the year is it? Do you think the larkspur seeds planted themselves in neat rows like this? What has someone done? (transplanted them) Will these seedlings grow into larkspur plants? Will these seedlings produce flowers like those in Picture 4? Will the plant produce seeds like those in Picture 6?"

Extending and Enriching Activities:

1. Collect seeds and seed pods. These may be labelled and placed on posters or in cases and later used in the flower-shop exhibit. (See next lesson, The Flower Shop.) One of the most successful ways of mounting seeds is to put them in cellophane envelopes and label.
2. Compare seeds and seed pods. Elicit that plants produce characteristic seeds and pods.
3. Trace the life cycle of other plants.

Pages 60-61

Relation to the Unit: To promote the ability to distinguish between living and non-living things; to show that plants provide esthetic pleasure.

Concepts:

A. Some things are alive.
B. Some things are not alive.
C. Living things grow.
D. Some plants provide esthetic pleasure.

Information for the Teacher: It is not necessary that the pupils use the words or know the meaning of *animate* and *inanimate*. It is sufficient that they recognize that many of the things about them are not alive, that many things are living, and that animals and plants are alive.

Procedure: Have the pupils name some things in the schoolroom that are alive (plants and animals) and some things that are not alive. (desks, books, etc.) Then have the pupils turn to pages 60-61. Read the title and discuss the picture of the flower shop. Explain that it is close to Easter, and so the florist has many plants and flowers in the shop. The pupils may name the plants and flowers—the lilies, ivy, tulips, pussy willows, etc.—but plant identification is not the main purpose of the lesson.

Say: "Let's pretend the florist needs more growing plants and cut flowers, because she knows that she is going to sell many. Everyone likes to buy plants or flowers at Easter time to make his home beautiful. Let's pretend we are getting more plants and cut flowers for the florist. Look at page 61. Pick out the plants and cut flowers for the florist.

"The plants and cut flowers we picked out were alive, weren't they? Let us find some things that are alive but are not plants. (dog and parrot) What things are left? (string, box, etc., or things that are not alive) Can the string grow? Can the scissors grow? Can the box grow? Can the tulip grow? Can dog and parrot grow? Are the dog and parrot alive? What can plants and animals do that string, ribbon, and scissors cannot do?"

Extending and Enriching Activities:

1. Examine the flower shop and pick out the living and non-living things; the plants and the animals.
2. Make up riddles about living and non-living things.
3. Build a flower shop or greenhouse and use it to exhibit the work and activities of the unit. If the pupils wish to keep living plants in the shop, they should be cautioned that plants need sunshine. Unless sunshine is available in the shop, the plants should be put on the window sills for at least two hours each day.

   A flower shop or greenhouse may be successfully made with large construction blocks or orange crates, and glassine, cellophane, or tissue paper for windows or skylights. Seed flats, window boxes, and pots may be used for the plants.
4. Find out about arranging cut flowers artistically. Use available flowers and various types of holders to achieve effects.
5. Discuss the care of cut flowers and house plants.

Page 62

Relation to the Unit: To demonstrate how trees provide pleasure for human beings; to review informally the names of tree parts so that they may be used in discussing and classifying trees.

Information for the Teacher: Although it is not necessary for the pupils to define a tree, they should perceive that generally a tree has a woody main stem, customarily without lateral branches, which culminates in a head of foliage and branches.

Procedure: Read the title. Have the pupils examine each picture, and tell how the tree provides fun for children. Throughout the work stress the parts of the tree which are shown in each picture.

The pupils should note that there is bark on the trunk and the branches, that the branches are found near the top of the tree, and that the leaves grow out of the branches. Elicit that the trunk of a tree corresponds to the stem of other plants. Develop meaningfully such words as *trunk*, *bark*, *woody*, *branches*, *leaves*, *twigs*, *roots*, *evergreen*, etc.

Extending and Enriching Activities:

1. Although food-making by plants should not be discussed at this level, some of the functions of tree parts may be elicited: the roots anchor the trees firmly in the ground, the trunk supports the branches, the branches hold the leaves into the sunlight, etc.
2. Collect and observe tree flowers and tree seeds.
3. If this unit is studied during the late winter or early spring, cut twigs from trees and examine the winter buds, particularly noting the protective covering.

Page 63

Relation to the Unit: To stress the value of trees and to indicate ways in which trees may be distinguished from one another.

Concepts:

A. There are many kinds of trees.
B. Trees have characteristic shapes.
C. Leaves of trees have characteristic shapes.
D. Some trees provide people and animals with shelter.

Information for the Teacher: The trees shown in the pictures are oak, maple, elm, and birch.

Procedure: Read the title and have the pupils discuss the value of shade trees; how bare our homes and streets would be without trees; how shade trees reduce the effects of summer heat when planted near a house; how farm animals often congregate under a tree on hot summer days, etc.

The pupils should examine each of the pictured trees and its leaf. They should note how the shape of each kind of tree differs from the others, and how the shape of the leaves on one kind of tree differs from the shape of the leaves on the other kinds of trees. (Be sure that the pupils understand that oak trees always have oak leaves, etc.)

Extending and Enriching Activities:

1. Make a leaf collection, using the leaves for leaf books or posters. The leaves can be pressed or printed. (See Appendix, page 159.)
2. Observe and list the trees found in the schoolyard or at home.
3. Draw or collect pictures of local trees. (If the pupils make drawings, the teacher should insist upon accuracy of general tree shape. If the pupils are not sufficiently mature to do this successfully, it is wiser to collect pictures or photographs.)
4. Make a chart of tree plantings in the schoolyard or at home.
5. Plant a tree.
6. If samples of various woods can be obtained, charts combining wood samples, leaves, and pictures or photographs of trees may be made.
7. Make blueprints of leaves for posters.
8. Make decorative plaster plaques of leaves. (See Appendix, page 159.)
9. Discuss other ways in which trees are useful to man.

Page 64

Relation to the Unit: To stress the value of trees and to indicate ways in which trees may be distinguished from one another.

Concepts:

A. Trees are called plants.
B. Some plants provide man with food.
C. Fruits have characteristic shapes.

Information for the Teacher: Pupils at this level are usually too immature to understand that *fruit* does not necessarily mean edible fruit. Consequently, no effort should be made here to enlarge the meaning of the word *fruit*.

Procedure: If possible, some of the fruits shown, sprays of budded branches, and leaves of trees shown should be brought into the classroom for direct observation. Budded branches may be forced. (See Appendix, page 159.)

Recall the shade trees studied in the preceding lesson. Ask about other ways in which trees are of use to man.

Distribute the books and have the pupils turn to

page 64. They should discuss the pictures, identifying the fruit—pear, cherry, orange, and plum—and noting the shape of the trees. Have them compare the general shape of the trees with those shown on page 63.

Extending and Enriching Activities:

1. If possible, examine a fruit tree from which the petals are falling and note the formation of fruit.
2. Observe and discuss other fruit trees and fruit-bearing bushes found in the locality.
3. Cut a pear, apple, cherry, orange, etc., apart and find the seeds.
4. Sprout orange or grapefruit seeds.
5. Visit the grocery store to find out what fruits are available.
6. If possible, visit a fruit orchard to observe spraying, harvesting, or pruning, according to the season. Discuss care of fruit trees.
7. Recall or reëxamine the work on weather predictions and reports. Determine the value of weather reports and predictions to the fruit grower.

Page 65

Relation to the Unit: To extend the understanding that plants are valuable to man for many reasons.

Concept: Many plants provide man with food.

Procedure: This lesson may be preceded or followed by a visit to the grocery store to study the commonly available foods which are obtained directly from plants.

Have the pupils study the picture carefully to determine the kinds of plant foods shown. The pupils should name as many of the fruits and vegetables as possible.

Call particular attention next to the less obvious plant foods, such as flour, cereal, and canned tomatoes. Point out that many foods will not "last" if they are not preserved in some way. Canning is one way of preserving perishable foods.

Discuss how wheat is ground to produce flour and name various ways in which we use flour. (bread, cakes, pies, etc.)

Extending and Enriching Activities:

1. If possible, visit a local cannery and observe commercial canning methods.
2. Can some tomatoes. In the work stress the need for cleanliness, sanitation, sterilization, etc., in food preservation.
3. Visit a grocery store to see the different frozen foods.
4. If possible, visit a home in which there is a freezing unit and observe how food is prepared in the home for freezing.
5. Discuss edible fruits other than those found on trees: strawberries, melons, raspberries, etc. Examine some of these to find the seeds and note the type of plant on which they grow.
6. Build and use a play grocery store.

Page 66

Relation to the Unit: To present certain edible plants.

Concepts:

A. We eat the seeds of some plants.
B. We eat the stems of some plants.
C. We eat the leaves of some plants.
D. We eat the roots of some plants.

Procedure: Review quickly the work on edible plants presented on page 65. Recall the names of parts of plants: roots, leaves, seeds, stems. (Unless the pupils are familiar with such vegetables as broccoli, artichokes, cauliflower, etc., flowers need not be stressed.)

Have the pupils examine each of the pictures and decide what part of the plant is usually eaten. The vegetables should be classified as follows: celery (stems and young leaves); asparagus (stems); radishes and carrots (roots); lettuce and cabbage (leaves); peas and corn (seeds).

Extending and Enriching Activities:

1. Make pictures of the vegetables eaten at dinner or supper and name the part of the plant which was eaten.
2. Many children are surprised to learn that the corn they eat is the seed of the plant. This may be demonstrated by sprouting a kernel of corn.
3. Plan a small vegetable garden for the home. Discuss preparation of the soil, kinds of vegetables to be raised, when to plant, whether to raise from seed or seedlings, probable time of harvest, and cultivation and care of plants.
4. Continue the work on plant foods. Make posters of locally grown crops, etc.
5. Raise lettuce, radishes, or other rapid-growing

seeds in a window box. Follow the directions on the packet. For indoor growth, plant seeds not so deep as for growing outdoors. (See Appendix, page 158.)

Page 67

Relation to the Unit: To demonstrate the esthetic value of plants grown outdoors.

Concept: Many types of plants are used to beautify homes.

Procedure: If a new house has been completed in the neighborhood and has not yet been landscaped, discuss the house and its surroundings. Elicit that the house itself is pretty, but it does not look so pretty as it will later when the grounds have been landscaped. Decide how plants may beautify it.

Say: "On the next page of *Look and Learn* is a picture of a new house. The house itself is very pretty. Something could be done to make the yard pretty, also. Look at the second picture. What has been done? Do you think the yard looks better? How will the people in this house have to take care of their new grass?"

Continue with the remaining pictures, pointing out the various improvements pictured. Stress also uses of plants other than for ornamentation—if there were no grass, the soil would soon be washed away, etc. Demonstrate by pouring water over slightly graded sand in the sand table. Call attention to the resultant gullies. Elicit that the small vegetable garden will give food, the flowers give beauty in the house as well as in the yard, etc.

Extending and Enriching Activities:

1. Duplicate the story on the sand table. Grass may be grown, twigs of live trees may be kept green for some time in damp sand, artificial flowers for the garden may be made, etc.
2. Discuss the work involved in landscaping a yard: soil preparation, care of a new lawn, planning a garden, finding out how trees should be planted, etc.
3. Plan ways in which to make the schoolroom more attractive through the use of plants. Plan possible rotation of plants and flowers to give variety of appearance. Review the requirements of plant life. A committee may be appointed to carry out these plans.

Pages 68-69

Relation to the Unit: To summarize the unit; to provide stimuli for discussion of the many ways people and animals use plants.

Procedure: Explain to the pupils that each picture illustrates a way in which plants are used by man or animals. Ask the pupils to study the picture and then tell the way in which the plant is used. Reading from left to right the most obvious response should be food, beauty, food, protection from wind, protection from sun, food, lumber, clothing, beauty, food, food, food.

Extending and Enriching Activities:

1. Make a series of posters or a mural to show the use of plants in the local environment. This should include plants as food, plants as shelter, and plants for other specialized uses.
2. Exhibit products obtained from plants, such as cotton goods.
3. Assemble a collection of plants, animals, and non-living things (pictures or specimens), classified as *Living Things: Plants, Animals;* and *Non-living Things.*

Upon Completion of the Unit

Using the flower shop as a background, hold an exhibit of posters, pictures, construction, and experimental work of the plant unit. If the season permits, give prizes for the best garden produce and flowers. Make "movies" as in Unit One (see page 20 of the *Guidebook*) of the trip that the class considers most interesting. Invite parents, another class, or friends to see the exhibit.

GUIDEBOOK for All Around Us

UNIT 1 Animals

General Concepts

A. Animals may be classified into groups according to their general physical characteristics.
B. Animals follow a definite pattern of growth.
C. Animals must have food to live and grow.
D. Baby animals receive varying degrees of parental care and protection.

(For a more detailed outline, see Index to Concepts, pages 78-80 of *All Around Us.*)

Introducing the Book

All Around Us should be presented as an interesting and unusual picture book. Display the book and discuss the meaning of the title with the children. Then say, "What did you see on your way to school this morning? Tell us one thing." After several pupils have mentioned something they saw, turn to a page in *All Around Us* which shows something mentioned by one pupil and say, "On this page I see something that Mary said that she saw on her way to school. Who would like to come up and point to it? Would you like to look for a picture of something you saw?" Distribute copies of the book to the pupils and allow them to make comments about the cover. As they open the book, direct attention to the title page by comments such as, "The name of this book is *All Around Us.* When we study the pictures in the book, we will learn much that is new and interesting about things all around us like the baby birds at the top of this page." Let the pupils glance through the book, locating and commenting upon pictures of things they saw on their way to school and about which they would like to learn.

Note: At this time the teacher should consult the Appendix of this *Guidebook* for suggestions on providing first-hand experiences with plants and animals. The collection of insects and small mammals should be started now, so that facts gained from the study of the book may be implemented by knowledge gained from observation of the habits of animals over a long period.

Page 3

Relation to the Unit: To introduce the unit's center of interest; to provide the teacher with an opportunity to explore the children's background in this area.

Procedure: Chapter title pages should be used by the teacher to arouse the children's interest in the unit to be studied, to estimate informally the scope of the children's knowledge in the general science area, and to assist in uncovering gaps in understanding that need to be considered in subsequent teaching procedures. The children, of course, should not be aware of these latter aims.

There are many ways in which page 3 might be presented, and much of the discussion depends upon the interest and background of the class. After the book itself has been introduced, the page might be presented and developed somewhat along the following lines.

Show the children page 3 and have them find it in their books. Say, "This page tells us what the first part of our book is about. What do you see on this page?" Notice how many of the animals—bluejays, raccoon, bear, skunk, chipmunk, fox, butterfly, and beetle—are correctly named, and then give help with any unfamiliar animal names. "Have you ever seen any of these animals? Tell us about them." Encourage discussion drawn from the children's actual experience. "What is a good name for all of these?" Elicit the generic term *animals.* "What will the first part of our new book be about? Let's glance quickly through the pages to see whether we are right."

Say, "Turn back to page 3. Can we tell whether all the animals shown are baby animals? Why not?" Elicit that one common way to tell whether these are baby animals would be to compare them with full-grown adults. Children should comprehend that one characteristic of immaturity is usually comparative smallness in size. This is not always true, of course. "Are there any animals that you are

quite sure are babies?" Note whether the pupils point out the inadequate wing and tail structure of the bluejays, the lard pail as a rough device for estimating the size of the cub, and the relative sizes of the toadstool and the chipmunk, the butterfly and the fox. After noting the responses, give whatever help is needed. Determine whether, after children note the size of the cub, the chipmunk, and the fox, they have in mind rough approximations of the size of the adults.

"Do you suppose any of these animals have their pictures in the first part of our book? Perhaps there are whole stories about some of them. Before we ask (name of child) to find out whether the bluejay is shown on other pages, let's decide just how he will make sure whether the animals he sees are bluejays. First of all, of course, he should be sure he is looking at a bird!" Elicit some general information about the characteristics of birds. Too detailed analysis should not be required, but responses should indicate the extent of the children's understanding of the term *bird*. "When (name of child) is looking at a bird, how will he know whether it is a bluejay or not?" Notice whether the children merely state the main color of the bird or include such items as wing marking, breast color, shape of head and bill, etc. It is not expected that the children will name all the distinguishing features that might be used, but the children's ability to describe and characterize should be noted.

Continue in the same way with the remaining animals, having various children search through Unit I to determine whether the animals appear in the subsequent lessons. Probably the pupils will include the moths on pages 13-14 in their search for butterflies. No issue should be made of the matter at this time, but say, "These really are not butterflies. They are moths. Moths look much like butterflies, though there are differences. When we study page 13, we shall talk about the differences between moths and butterflies."

Description of each animal should precede the search, and careful notations should be made of the completeness of the descriptions: whether descriptions are confined to color and markings, whether they include reference to general shape and structure, and whether they include detailed analysis. It is also advisable to give close attention to the children who search for the various animals. The confidence with which the child undertakes the task, the method he uses (whether he leafs through at random or begins at page 4 and progresses methodically; whether he readily recognizes the end of the animal unit or continues far into subsequent units; whether he examines each page with unnecessary care, glances too casually at each page, or uses good judgment in his time allotment to a page), the completeness of his search, and the scope and language of his report are all helpful in evaluating the child's development.

Conclude the lesson by saying, "We shall learn many things about some of the animals on this page. I think we shall learn about other animals, too. Next time we are going to have a story about some animals just like one of the animals on this page."

Pages 4-5

Relation to the Unit: To introduce in story form major concepts of the unit.

Concepts: Animals follow a definite pattern of growth; animals must have food to live and grow; some baby animals get parental care and protection.

Information for the Teacher: The fox litter, which may number as many as nine, is born around the first of April. The cubs are kitten-like in appearance and are covered with soft, fine, short hair. Their eyes remain closed until the eighth or ninth day, and the cubs stay in the den from three to four weeks. When the babies are about three months old, they are weaned; however, they eat some solid food before this. By the end of August they are full-grown. Then they scatter, each fox to establish a den of its own.

The teacher will note in this lesson, as well as in subsequent lessons of the same type, that not all the young animals are shown in each picture. This is done to permit the drawing of larger illustrations.

During the lesson develop the meaning of such words as *litter*, *den*, *scent*, *tracking*, *shelter*, etc.

Procedure: Before passing out the books, display pages 4 and 5, read the title "The Fox Family," and explain that the eight pictures

show how a hungry family was fed. Tell the pupils that the pictures on each page are to be read in the same way as the "funnies." Indicate the order of progression on page 4 and then on page 5.

After the books have been distributed, allow the pupils to scan the pictures and make comments freely about each one before beginning a systematic study of the two pages.

Direct the pupils to look at the first picture. Then ask, "Where is the foxes' den?" Lead them to notice that the den is the hollow trunk of a fallen tree. "What did the mother use to line the nest? Why do the babies need care?" Through discussion bring out the fact that their eyes are not open, their legs are wobbly, and their fur is short. "What kind of food do they get? What else does the mother do for the babies besides feed them?"

Continue by saying, "Look at the next picture. How can you tell that time has gone by?" The pupils should include in their responses that the babies are larger and stronger, their eyes are open, their fur has grown longer, and they look much more like their mother than they did before. "Do they now eat the same kind of food as their parents?"

In the discussion of the third picture point out that the young foxes are old enough to go outside the den. Then ask, "How do the babies spend much of their time? How is this playing good for the babies?" Elicit that the exercise develops their muscles and teaches them how to use their teeth.

"In the fourth picture the babies are not shown. They are in the den. They are now so old that they no longer drink milk. They eat the same sort of food that the parents do. Where do you think the father is going? Why doesn't the mother go with him? What dangers may the father meet?"

Ask, "What is happening in the fifth picture? If the father got out of sight, do you think the dogs could still follow him? How? Have you ever been followed by a dog who smelled your footsteps?" Encourage the pupils to tell of their experiences with animals which tracked them.

"What is the fox doing in the sixth picture? Can the dogs follow his tracks now?" If the children are unable to answer, tell them that the fox breaks his tracks by jumping across the water.

"What do the dogs do when they reach the place where the wise fox leaped to the rocks? Do you think they will be able to track him farther?" Be sure the pupils understand that the dogs will lose the scent at this point, and the fox will escape.

"What did the fox catch that day? What did he do with it?" Explain to the pupils that, while foxes do occasionally steal hens, they do so only because they need food. They repay the farmer in part by the great number of mice and rats they kill.

Narrative Interpretation: Say to the pupils, "Now we are ready to tell the story. How would you begin it?" Have different pupils discuss each picture. Use guiding questions or comments to direct the narrative so that it includes much descriptive detail.

Extending and Enriching Activities:

1. The pupils should begin to make collections of animal pictures, particularly of young animals. As far as possible, pictures in color should be selected and should be individually mounted so that they can be used for various types of study and discussion.* (See Appendix, page 157.)
2. The pupils may list and discuss other animals that they know which, like the fox, are born, fed mother's milk, and sheltered from harm.
3. Discuss other animal homes, using such terms as *den*, *cave*, *nest*, *burrow*, etc. The function of the home as a shelter should be stressed.

Page 6

Relation to the Unit: To promote the concept that animals may be classified into groups according to general physical characteristics.

Concepts:

A. Birds have bodies covered with feathers.
B. They have two legs and two wings.

Information for the Teacher: The pupils have already learned in *Look and Learn* that animals can be distinguished by physical characteristics and that these characteristics are used as

* If the class started a collection of this nature in Grade 1, it may be borrowed and extended.

a basis for classification. The idea of using characteristics as a basis for differentiation is reviewed at this point because the techniques of comparing and contrasting are necessary to derive the concepts that are developed throughout the unit.

In addition to the characteristics listed above, birds have no teeth, they are warm-blooded, and they breathe with lungs. These characteristics, however, are not brought out at this level.

The names of the animals used in the lesson are cardinal, hen, mourning dove, chipmunk; black panther, eagle, parrot, goose; bluejay, duck, lamb, sparrow. The pupils are not expected to learn or use the names unless they are familiar. When the names are known, or when the pupils themselves evince interest in them, it is highly desirable to use them.

In the discussion review the meaning of such words as *bills*, *wings*, *feathers*, *beak*, etc.

Procedure: Direct attention to the first row of animals and say, "Which three animals in this row are most alike? In what ways are they alike?" The children should include in their responses such things as the number of legs, the wings, the feather body covering, the bills, etc. Ask, "In what ways is the other animal different?"

Continue in the same manner with all the rows, having the pupils point out the similarities and differences.

After comparing the animals in all the rows, say, "What has the artist painted in the colored bands? Are all the feathers the same size and shape? Where on a bird do you find the big feathers? Where do you find the little soft feathers?" Encourage the pupils to describe various kinds of feathers that they have seen.

At the close of the discussion say, "In what ways are all the animals except three on this page alike?" Help the pupils make the generalization that all birds have bodies covered with feathers, have two legs, and two wings.

Extending and Enriching Activities:

1. The pupils will derive enjoyment from making a feather collection which may be displayed on the classroom bulletin board.
2. Add bird pictures to the animal collection. These bird pictures may be used to supplement the discussion if the teacher desires to present additional examples of birds.
3. As generalizations are made on this and succeeding lessons, the pupils should be encouraged to play charades and guessing games and to work puzzles that will help to drive home the generalizations.
4. Take the children on a field trip and have them compare and contrast the birds and animals they see.

Page 7

Relation to the Unit: To extend the concept of animal classification developed on page 6.

Concepts:

A. Insects have six legs.
B. They have two feelers, or antennae.

Information for the Teacher: Other characteristics of insects are that they have a hard body covering and that their bodies are divided into three parts. Unless activity 3 of this lesson plan is carried out, neither of these characteristics should be brought out at this level.

If the children know that some kinds of ants have wings, though the one in the picture has none, include that fact as an item of similarity in discussing the ant. All the insects on this page except the ant have wings, as do the *majority* of insects, but the teacher should be careful not to set up the idea that all insects have wings.

Spiders are often erroneously called insects. In discussing the last row, have the pupils note the eight legs, which make the spider different from the insects. If children ask what spiders, centipedes, and frogs are called, they are arachnids, myriapods, and amphibians.

The names of the animals used in this lesson are ant, bee, tree frog, fly; grasshopper, mosquito, firefly, centipede; cricket, spider, dragonfly, wasp.

In the discussion develop such words as *insects*, *body*, *antennae*, *feelers*, *parts*, *centipede*, *marking*, etc.

Procedure: Direct attention to the first row of animals and have the pupils identify them. Encourage the pupils to tell what they know about each. Ask, "How is the ant's body different from the tree frog's body?" Elicit that the ant has six legs. Then ask, "What does it have on its head that the tree frog does not have?" Lead the pupils to notice that it has "feelers," or "antennae." Ask the pupils if they have ever

seen feelers on any other animals and what the animals seemed to be doing with them. (Antennae are organs of sensation, chiefly of touch.) Now direct the children to look at all the animals in this row and ask, "Which three are most alike? In what ways are they alike?" The pupils' responses should include the facts that the ant, the bee, and the fly all have six legs and that they have antennae on their heads. Then ask, "Which two are alike in another way?" Lead the pupils to say that the bee and the fly have wings. "What general name could be given to the three animals in this row that are most alike?" If the children answer "bug," supply the correct word, "insect," for them.

Continue with all the rows, having the pupils point out similarities and differences.

After a discussion of the likenesses and differences of the animals in each row, have the pupils compare all the animals on the page. To lead the class to make the generalization that all of them but the spider, the centipede, and the tree frog are insects, ask the questions, "What animals on the page are not insects? Why not?"

At the close of the discussion period, have the children tell what the artist has drawn in the colored panels on the page and then say, "Which insect on this page has no wings? Some insects do not have wings. Which insects on this page do have wings? Many insects have wings. How do the wings of insects differ from those of birds?" Elicit that they are thin, transparent, and unfeathered.

Extending and Enriching Activities:

1. Make a collection of insect specimens if the children's interest and the season warrant. (See Appendix, page 157.)
2. Whether or not a large insect collection is to be made, some specimens should be brought into the classroom. Compare the wing structure with that of a bird, note the leg construction, etc.
3. With actual specimens before the class, elicit that insects have a third characteristic not previously discussed; namely, bodies divided into three parts. After several specimens have been examined to verify this generalization, the pupils should reëxamine page 7 and find similar body divisions. In some cases, of course, the three-part division is not obvious because of the wings.

Pages 8-9

Relation to the Unit: To review the concept presented in *Look and Learn* that most baby animals resemble their parents more closely than they resemble other animals.

Concepts:

A. Baby animals are smaller than their parents.
B. Baby animals may differ in color and markings.
C. Baby animals may differ in minor structural details.
D. Baby animals usually resemble their parents in gross structure.

Information for the Teacher: The animals pictured on page 8 are cats, kittens, rabbits, puppies; puppies, raccoons, chipmunks, dogs; deer, mountain lion cub, fawn, kid; chicks, chickens, goslings, owlets.

Those shown on page 9 are elephants, rhinoceros, giraffe, baby elephant (calf); lion cubs, monkey, zebra, lions; hogs, fox, wolf, pigs; horses, panda, colt, calf.

Procedure: Direct attention to the animals in the top row on page 8 and say, "Are all these animals alike? How are they different? Are they all the same size—the same color—the same shape? Do they all have the same kind of ears—eyes—tails? Two of the animals in this row are grown-ups. Can you find them? How do you know? Which animals in this row are their babies? How can you tell? In what ways are the babies like their parents? Do the babies and the parents look exactly alike? How are they different? How did you know the puppies and the baby rabbits did not belong to the mother and father cats?" If the pupils merely respond that cats do not have puppies or rabbits, direct their attention again to physical differences between the cats and the other animals in the row. Make sure that pupils note such details as the shape of the ears as well as gross body structure and coloring.

Continue in the same manner with the other rows on pages 8 and 9. In row 2 on page 8 lead the pupils to notice that the babies are identical to the parents in color and marking; whereas the kittens were similar but not identical. In rows 3 and 4, page 8, and rows 1 and 2, page 9, note that the differences are those of minor structural details (for example, spots,

antlers, combs, spurs, different type of feathers, tusks, mane, tails). The children should notice that the puppies, baby pigs, and colt are almost exactly like their parents.

To strengthen the generalization that baby animals resemble their parents more closely than they do other animals, ask, "In the first row, page 8, in what ways are the kittens most like their parents?" Continue in the same manner with the other rows on pages 8 and 9.

Extending and Enriching Activities:

1. To review the important skill of comparing and contrasting physical characteristics of animals the teacher may ask, "Find all the animals on pages 8 and 9 that have two legs—four legs—long legs—webbed feet. Which animals have bodies covered with fur —feathers? Which have spots—stripes? How many have long ears—long tails—bills, etc.?"
2. Pictures of three or four mature animals may be shown along with one baby animal. The pupils should select the parent of the baby animal and justify their choice.

Page 10

Relation to the Unit: To present stages in the growth of a mammal from birth to maturity; to present certain common distinguishing characteristics of mammals.

Concepts:

A. Mammals are born.
B. Baby mammals get milk from the mother's body.
C. Mammals have hair on their bodies.
D. Mammals at birth resemble their parents.
E. Baby mammals increase in size until maturity.
F. As mammals grow, they change in ability to do things.

Information for the Teacher: The young in the first small picture are newly born; in the second, about three weeks old; in the third, about four months; and in the last, six months. At this time they are fully grown, although they may stay with their mother until they are a year old.

If desired, tell the pupils that skunks are born just as kittens and puppies are. It is satisfactory if children give "born" the connotation common at this level: that they can see the actual animal rather than merely the egg; that it is a recognizable living entity similar to the parent; that it eats in the sense that the child understands eating—in this case by drinking milk from the mother's body. A skunk is weaned at two months.

During the discussion develop such words as *born*, *nurse*, *solid food*, *strong*, *mammals*, etc.

Procedure: Have the pupils identify the animal at the top of the page and tell anything that they know about skunks. Then direct them to study the first picture below. Say, "In what ways are the baby skunks like their mother? Are they the same shape? Are their bodies marked the same? How are they different? Are they the same size—the same color? Do they have tails and fur like their mother?" Lead the pupils to see that the pink color of the newly born skunk is due to the fact that it is nearly hairless. Then ask, "Do you think that the baby skunks could take care of themselves? Why not?" Make sure that the pupils note that the babies are almost helpless, for their eyes are closed, their legs are unsteady, and they have no protection from the cold. "What kind of food do these babies get? Why do they need food?"

After the pupils have studied the second small picture, ask, "How can you tell that time has gone by?" Pupil responses should include the ideas that the babies look larger and more like their mother, although their fur is still not as long and fluffy as hers. "Do you think they still need their mother? Why? In the next picture are the skunks older? Why do you think so? In what ways do they look more like their mother now? What do you think they might be looking for? (food) In the last picture the skunks are fully grown. What do you think they can do for themselves now?" Through discussion bring out the fact that, because skunks feed on insects and rodents that are injurious to crops, they should not be killed.

In order to summarize for the class the progressive changes in size and independence of the babies, say, "Tell us how skunks grow and develop." Assist children to tell how the skunks look and what they can do at birth, at three weeks, at four months, and at maturity. To help the children make the generalization that animals with certain common distinguishing characteristics are mammals, have the pupils turn to page 4 and tell in what ways the baby

skunks and baby foxes are alike. As they give the likenesses (they are born, drink milk from the mother's body, have hair), list them on the board. Conclude the lesson by saying, "We call animals about whom we can say these things *mammals*."

Extending and Enriching Activities:

1. If regulations permit, bring a pair of white mice or rats to the classroom and keep them in a place convenient for observation.
2. Reëxamine pages 8-9 and decide whether the parents and their young in each row are mammals. Since the young are not shown feeding, the teacher should give prompt help when it is needed.
3. Classify the animals in the picture collection on the basis of whether or not they are mammals.
4. Begin making a large chart, using both pictures and simple text, which can be added to as the work progresses, of various animal groups and their characteristics. At this stage the children have learned, and the chart might depict, the following:

ANIMALS

Mammals	*Birds*
Mammals are born.	Birds have feathers.
Mammals nurse.	Birds have two wings.
Mammals have hair.	Birds have two legs.

Insects

Insects have six legs.
Insects have two feelers, or antennae.
Insects often have wings.

Additional information should be added as it is developed in future lessons.

Page 11

Relation to the Unit: To present stages in the growth of a bird (the scarlet tanager) from egg to maturity.

Concepts:

A. Birds hatch from eggs.
B. Birds increase in size until maturity is reached.
C. Baby birds vary in color and texture of plumage from the parents but resemble them at maturity.
D. Frequently male and female birds differ in plumage.
E. As birds develop, their ability to do things changes.

Information for the Teacher: The scarlet tanager, which breeds in the eastern part of both Canada and the United States, has been called "the guardian of the oaks," since its food is largely animal matter—moths, beetles, caterpillars, ants, and grasshoppers, all of which are often injurious to trees.

The male tanager passes through an interesting sequence of plumage changes. When the young birds leave the nest, the plumage of the male and female is alike. By fall the male is yellower and has browner wings than the female. In this dress the male goes to South America for the winter, during which time he acquires a pale red body and a black tail, but retains the brownish wings. In this garb he comes north again, mates, and rears his young. Following the nesting season he molts, and the new plumage is yellowish green with black wings. When he again goes south, he looks much like the female. During the second winter he becomes a deep scarlet with black wings and tail, the characteristic coloring of the adult male tanager. Twice a year thereafter the body color is changed—from scarlet to yellowish green in the north, and from yellowish green to scarlet in the south.

In the discussion develop such words as *tanager*, *male*, *female*, *coloring*, *plumage* (optional), etc.

Procedure: Direct attention to the picture at the top of the page. Ask, "Have you ever seen a bird like this one? Do you know its name?" If the children are unable to answer, tell them that it is a scarlet tanager and explain that this one is the male, or father. Then have them look at the picture in the lower right-hand corner. Say, "Here we see both the father and the mother scarlet tanager. How is the coloring of the mother different from that of the father? Do you know any other kind of bird in which the male and female have different coloring?"

"Look at the first small picture. How many eggs do you see in the nest? What color are they?" Have the children note the loose construction of the nest, which merely rests upon

a fork in the branches, and talk about the way in which birds make nests.

"How many baby birds do you see in the second small picture? Where did they come from? In what ways do they look like their parents? How are they different? Do you think these little birds could fly? Why not?" The children should notice the half-naked bodies of the baby birds and their lack of strength. Ask, "Why do you suppose they are looking outward and one has his mouth open? Where do you think the parents are?"

Tell the pupils that the little birds in the third picture are from two to three weeks old. Lead the children to see the changes that have taken place in the little birds' plumage, in their ability to get around, and in the appearance of the eyes. Then compare the babies with the adults in the last picture, bringing out the fact that the babies do not have well-developed wings or tails, and thus are unable to fly. Contrast their coloring with that of the adult birds and explain that the female birds, when full-grown, will resemble the mother and the male birds will resemble the father. Conclude the lesson by asking, "How is the development of a bird different from that of a skunk? How is it alike?"

Extending and Enriching Activities:

1. Put up a birdhouse in the schoolyard, if possible, so that the children may actually observe the growth of young birds.
2. Make a big chart and, as the pupils report seeing some bird native to the community, mount a picture of that bird.
3. Add information to the large animal chart begun in the previous lesson.
4. List things that the baby birds can do when they are mature. Such a list might include: they fly; they find their own food; they make nests. Discuss other animals and stress the fact that reaching maturity implies more than completing physical growth.
5. Have the pupils list skills and abilities that develop in human beings, such as being able to walk, learning to read and write, being able to feed oneself, bathe oneself, balance on skates and bicycles, earn money, support a family, etc. Have the pupils name the things that they can do but babies cannot do; have them name the things that they can do now but could not do in kindergarten.

Page 12

Relation to the Unit: To present the stages in the growth of a frog from egg to maturity.

Concepts:

A. Frogs hatch from eggs.
B. Frogs do not resemble their parents when hatched but do resemble them at maturity.
C. Frogs pass through a series of structural changes before maturity is reached.
D. As frogs develop, their ability to do things changes.

Information for the Teacher: The mother frog deposits her eggs, often as many as 6000, on a water plant; and, as the jellylike substance with which the eggs are surrounded swells, it glues or fastens the mass to the plant.

Children often confuse frogs and toads, but they can be distinguished in the following ways: the frog's skin is smooth and moist, while the toad's is rough and dry; the frog's color is more often green, the toad's brownish; the frog's face is more pointed than the toad's.

In the discussion develop such words as *mass*, *gills*, *tadpole* (or *polliwog*), *jellylike*, etc.

Procedure: Display the picture of the leopard frog and ask the children if they have ever seen a frog. Encourage them to talk of their experiences in connection with frogs. Tell the pupils that this frog is called a leopard frog, and that, as it grew from an egg, the shape of its body changed many times. These changes were so varied that the frog seemed almost to change from one kind of animal to another. Although mention should not be made of gills as contrasted with lungs, the children should understand that the initial stages of the animal's growth take place in water, and it is not until the tadpole develops a recognizable frog-structure that it can live partly on land.

Tell the pupils, or elicit, that from February to May, depending upon the region, the female frog lays her eggs, which stick together, forming a sort of jellylike mass. Explain that the first picture in the lower section of the page shows the top side of one of the eggs greatly magnified. (In reality the brown spot is only about the size of the head of a common pin.) Then direct the children to follow the arrow around. Say, "The second picture shows the egg when it is a week old. How has it changed?"

Be sure they note the development of the young animal within the egg and lead them to see that the shape of the young tadpole is clearly visible.

Explain that in the third picture the tadpole has hatched and that it has grown large and strong enough to wiggle away from the mass of jelly. Ask if they know what the red fringes are. If no one knows, tell the pupils that these are the gills through which the tadpole breathes in the water. "Can you see the gills in the second picture, which shows the tadpole before it is hatched? Do you know any other animals that breathe with gills?" (Fishes.) "Where do animals that breathe with gills live?"

Have the children follow the sequence of pictures, tracing the changes as the tadpole develops. Draw attention to the appearance of hind legs in the fifth picture. Tell the children that the front legs come out one at a time. Make sure they understand in the last two pictures that the tail does not drop off but is absorbed in such a manner that it gradually disappears, to vanish completely by the time the frog is about one and a half inches long.

Ask, "Does anyone know what happens to a frog's skin while the frog is growing?" If responses are vague, tell the pupils that the skin is shed five or six times a year, slitting down the middle of the back and the under side and down the tops of the four legs.

In summarizing the development of the frog, emphasize the egg, the tadpole (which is the first baby animal presented in this unit that after hatching really looks like a different kind of animal), and the adult. Pupils should understand that it takes about fourteen weeks for the egg to develop into a frog like the one at the end of the sequence of pictures. Ask, "Where does this animal live when it is still in the egg and when it is a tadpole? (in the water) Where does it live when it has become a full grown frog?" (largely on land since it now has lungs and can breathe air) Recall the lessons on the skunk and the bird. Have the children compare the development of the frog with that of the skunk and the bird, noting likenesses and differences.

Extending and Enriching Activities:

1. Hatch some frog eggs. If possible, collect the eggs on a field trip. Frog eggs are better for an aquarium than toad eggs and may be easily distinguished because they are larger and are laid in masses instead of in strings. Bring several masses of frog eggs to the schoolroom and keep them in an aquarium where there are no other animals. Watch their development from day to day so that the children can actually see the stages in the development of a frog from egg to maturity.
2. Elicit, or point out, that a toad is very similar to a frog and follows the same structural changes in its development.

   Discuss and compare the length of time it takes for (a) a mature frog to develop from the egg, (b) a mature bird (tanager or other bird) to develop from the egg, (c) a mature mammal (skunk or fox) to develop from birth, and (d) an adult human being to develop from birth.
3. Name the things a frog can do that a tadpole cannot do; the things a tadpole can do that a frog cannot do.

Page 13

Relation to the Unit: To present the stages in the growth of a moth from egg to maturity.

Concepts:

A. Moths hatch from eggs.
B. Moths do not resemble their parents when hatched but do resemble them at maturity.
C. Moths pass through a series of structural changes before maturity is reached.

Information for the Teacher: A moth may be distinguished from a butterfly in several ways. A butterfly is active during the day; a moth, during the night. The antennae of the moth are branched and have no knobs at the tips. Those of the butterfly are smooth and have knobbed ends. The butterfly's wings, when at rest, are held upright over the insect's back; those of the moth, folded. The development of the *cecropia* moth from egg to adult takes approximately a year, the longest growth cycle presented so far.

In the discussion develop and review such words as *antennae*, *feathery* (as applied to a moth's antennae), *caterpillar*, *cocoon*, *spins*, *thread*, *development*, etc.

Procedure: Show the children the picture of the moth at the top of the page and ask them whether they have ever seen one and whether

they know its name. They may call it a butterfly. If so, give them the correct name, *moth* (Cecropia), and ask whether they have noticed or heard of any other moths. Direct their attention to the antennae and three body parts; tell them that moths have six legs. Say, "On page 7 we studied other animals like the moth. What general name did we give to them? What kind of animal do you think this one is?"

Tell the pupils that the female moth lays many eggs, sometimes as many as several dozen, on one leaf. Direct the children to follow the arrow around as they did in the frog series. Then ask, "What do you see on the leaf? What hatches from each moth egg?" If the pupils respond that a worm does, tell them that we call it a caterpillar, not a worm. Ask, "In what way is it like a worm? What happens to your skin as you grow?" Explain that the caterpillar does not have a skin that grows bigger as the animal grows, and ask, "Can you guess what happens when the caterpillar gets too big for its skin?" Have the pupils point out the picture that shows the caterpillar shedding its skin. Then say, "What other animal have we talked about that also sheds its skin as it grows?"

Ask, "What do you think the caterpillar is doing in the fifth picture?" Tell the pupils that the caterpillar spins a cocoon after it sheds its skin for the fourth time. "Where do you think it gets the thread for its cocoon?" Tell them that the caterpillar makes the thread in its body and that the thread comes out of its mouth. Tell them also that this thread, when it is first spun, is soft, but that it soon hardens in the air.

Direct the pupils to look at the sixth picture; then ask, "Where is the caterpillar?"

Draw attention in the seventh picture to the moth emerging from the cocoon. (Moths usually emerge in late May or early June.) Tell the children that the moth is full-grown as far as size is concerned, but that it is weak when it first emerges. After an hour or so in the air, the wings dry and the moth is strong enough to begin its adult life. Tell the children that grown-up moths are entirely harmless, since they never eat anything and live but a few days.

In summarizing the growth of the moth, emphasize the four stages of its development—egg, caterpillar, cocoon, and adult. Have the pupils compare this with the stages in the development of the frog. Ask, "How does the development of the moth differ from that of the frog? In what way is it like the development of the frog? How does it differ from the development of the skunk and the tanager?"

Extending and Enriching Activities:

1. Find a young caterpillar and bring it to the classroom so that the children may feed it.
2. Bring a cocoon into the classroom in the fall (cocoons are often found hanging on twigs of trees or lying among fallen leaves) and keep it carefully sheltered in sphagnum moss during the winter. Open the cocoon after the moth has emerged and note the papery outer covering, the loosely woven silk, and the inner shell.
3. If the season permits, bring insect eggs into the classroom. Otherwise, bring in pictures of insect eggs. Compare these with the eggs of birds, particularly with regard to size and outer coating.
4. Explain that, while all insects do not pass through the same stages as does the moth, they do undergo structural changes in developing from the egg to the adult stages. Using examples available in the locality, trace the development of several insects.
5. Add to the animal chart.

Page 14

Relation to the Unit: To determine the pupils' ability to apply concepts regarding the sequential nature of growth.

Information for the Teacher: Although toads pass through exactly the same cycle as frogs, toad eggs are black and are laid in strings; whereas frog eggs are black and white and are laid in masses. Unlike the frog tadpole, the toad tadpole remains almost jet black until its legs appear.

Procedure: Direct the pupils' attention to the first row of pictures. Ask, "In this row of pictures what animal grows up?" Have the children turn back to the frog on page 12. "How is the toad different from the frog?" After the likenesses and differences have been noted, continue with the discussion of the toad by saying, "In which picture is the toad the youngest? What do we call it? In which one is it partly grown up? Is it the same color as the partly grown-up frog on page 12? In which picture is the toad fully grown?"

Continue in the same way with the next two rows (screech owl and bluejay), having the pupils decide upon the correct sequential arrangement. Make sure that the children do not formulate the generalization that all baby birds are the same color as their parents and have the same kind of body covering.

Have the pupils indicate the correct sequential arrangement for the last row of pictures (Polyphemus moth), and then direct them to turn to page 13. Lead them to note the differences between the two moths, caterpillars, and cocoons.

Extending and Enriching Activities:

1. Make a chart, and on it mount pictures indicating the sequential nature of the growth of other animals. Pictures to use for this purpose may be obtained from magazines. The children may have pictures of their own pets taken at different stages in their growth.
2. Have the children bring to the classroom baby pictures of themselves and tell how they have changed since babyhood.
3. Study the class height and weight chart (or begin making one, if none exists) to trace changes in the pupils' height and weight as they grow older. Discuss other phases of human growth, particularly tooth development, increase in strength, and rise in intellectual and muscular skills.

Page 15

Relation to the Unit: To determine the pupils' ability to apply their knowledge of the common characteristics of mammals in distinguishing between animals that are born and those that are hatched.

Procedure: Direct attention to the first row of baby animals and have the pupils identify them. Then say, "Three of these baby animals are more like one another than they are like the fourth. Can you name the three? In what ways are they alike?" Elicit that they have the same general body parts and that their bodies are covered with hair. Then say, "Can you tell any other ways in which they are alike?" If the children hesitate in giving the correct reply—that they are born and that they get milk from the mother's body—refer to pages 4 and 10. Ask, "What general name do we give animals like these? In what way is the young bird different from the mammals?" The children's responses should include the facts that it differs in body form, parts, and covering, that it is hatched, and that, when it is a baby, it does not get milk from the mother's body but eats the same general kind of food as its parents.

Continue with the other rows, eliciting that the caterpillar in row 2 and the young frog in row 3 differ in general body appearance and covering from the other animals in those rows. Aid the children to recall that the frog and the caterpillar not only are hatched from eggs but also will pass through many changes in body form as they grow up. The other young animals pictured here do not do this.

Then say, "Look at the young bird, the caterpillar, the young frog, and the chick. Are they the same color? Are they the same shape? Do they have the same body covering? Do they grow up in the same way? There is one way in which these four animals are alike. Can you think what it is? Perhaps if you look at pages 11, 12, and 13, you can tell what this way of being alike is." Aid the children to formulate the generalization that, although these animals may differ in appearance and body parts, they can be considered alike in that they all were hatched from eggs.

Extending and Enriching Activity:

Reëxamine the pictures on page 3. Have the children select the mammals, justifying their selection; then select the birds; then the insects. If time and interest permit, continue with the animals on pages 4-5, 6, 7, 8-9, 10, 11, 14.

Pages 16-17

Relation to the Unit: To present in story sequence the concept that animals must have food to live and grow.

Procedure: Present the title "A Hungry Cat" and direct the pupils to interpret the picture sequence. Ask what kinds of food the cat tried to get and the reasons why in each case it failed. Lead them to notice that the animals escaped by swimming or flying away, by hiding, by retracting into a shell, or by fighting.

Bring out in the discussion that birds are sometimes eaten by cats, as are mice, fish, and insects; but stress the fact that an adequately fed cat is not very likely to attack birds.

Extending and Enriching Activities:

1. Encourage the children to tell humorous stories of adventures their pets have had while searching for food.
2. Discuss ways in which pets must be cared for and list the rules a good master follows in bringing up a pet.
3. Observe the kinds of food local animals eat, stressing the variety of most diets. Children are apt to have erroneous preconceived ideas, such as that cats eat only milk, dogs eat only meat, birds eat only worms, etc. This erroneous preconception should be changed, and the wide variety of foods acceptable to many animals should be stressed.
4. Discuss the importance of food as a factor in growth, life, and health.

Page 18

Relation to the Unit: To present an example of a baby bird that eats the same type of food as the parents but must be both fed and sheltered by them.

Concepts:

A. Young birds do not nurse but eat the same type of food as their parents.
B. Young birds that cannot move about competently are given help in getting food.
C. Young birds that cannot move about competently are sheltered by their parents until they can.
D. In the case of some birds both the male and female take care of the eggs and the young birds.

Information for the Teacher: The finches are primarily seed eaters, but they consume many insects and worms during the summer and wild fruits during the fall. The goldfinches bring up their youngsters for the great part on "cereals." These are served warm, for the parent birds swallow the seeds after cracking the hard coats and feed the youngsters by regurgitation.

Like the scarlet tanagers, the male goldfinches go through a plumage change. In the summer they are a brilliant yellow and black, while the females are a brownish yellow. In the winter, one can hardly distinguish the sexes, both being a brownish yellow, except that the males have somewhat blacker wings with more prominent white markings.

Procedure: Direct attention to the two pictures of the goldfinches at the top of the page. "Have you ever seen birds like these? Do you know their names? Can you guess which is the male and which is the female?" If the pupils cannot justify their answers, have them turn back to page 11 and note the brilliant coloring of the male tanager and the duller coloring of the female. At the same time they should note how the eggs of the tanager and the goldfinch differ.

Then direct attention to the third picture, in which the birds are about two days old, and tell the children how the little birds are fed. Ask, "Why can't the little birds get their own food? How is the way they are fed different from the way the baby skunks and foxes were fed?

"Which bird is on the nest in the fourth picture? What is she doing? Which bird is on the nest in the second picture? What is he doing?" Elicit that both the male and the female goldfinch share the responsibility of keeping the eggs warm until they are hatched and then of keeping the naked birds warm and sheltered from the wind and the sun.

Now direct attention to the fifth picture, in which the birds are from two to three weeks old, and say, "In what ways are the young birds like their parents? In what ways are they different? Do you think that these baby birds can fly—can hop? Can they get their own food now?" Lead the children to see that although the babies can hop and flutter about a little, they cannot fly to the ground to search for food.

In the discussion of the last picture, in which the young are three to four weeks old, ask, "Can the baby birds fly now? How do you know? Do they eat the same food as their parents? Can they get it for themselves? Why not?" Lead the class to see that although the young birds can fly to the ground, they are not mature enough to fly far nor experienced enough to locate their own food.

Direct the pupils to turn back to pages 4-5 and 10 and compare the care and feeding of the baby foxes and skunks with that of the baby goldfinches.

Extending and Enriching Activities:

1. Continue with the work of the bird chart started in connection with page 11.
2. If the season warrants, establish a feeding station for birds. (See Appendix, page 156.)

3. Study pictures of birds other than the tanager and finch in which there are color differences in the plumage of the male and female. The children should note that in these cases the male is usually more brilliantly colored than the female.
4. Find out what foods are commonly eaten by birds in the vicinity. After listing the diet of each bird, discuss the bird's value to the farmer.
5. If the lesson is studied at nesting time, put out material for nest building, particularly yarn cut in 8- to 12-inch lengths.
6. Make a study of bird calls, nest construction, or (in winter) bird tracks, etc., to develop other bases for distinguishing birds. Bird nests should be removed from trees and bushes only after the birds have abandoned them.

Page 19

Relation to the Unit: To present an example of a baby bird that eats the same food as the parents but does not have to be fed or sheltered by the parents for a long period of time.

Concepts:

A. Baby birds do not nurse but eat the same kind of food as their parents.
B. Many baby birds can move about competently immediately after hatching.
C. Baby animals that can move about independently do not require extensive help in getting food.
D. Baby animals that can move about competently are not given so much protection as those that cannot, nor are they given protection for so long a time.

Information for the Teacher: The eggs of the quail, twelve to eighteen in number, are laid in a nest built on the ground. Both the father and the mother share in the responsibilities of the incubation period, which lasts twenty-four days. The young are brooded at night for three weeks after they are hatched; then they care for themselves. By fall they are full-grown, but the family remains together until spring, often living with other quails in coveys. They gather at night in a compact circle, heads out and tails in; this arrangement affords both warmth and defense against enemies.

In the discussion develop such words as *quail, covey* (optional), *brood, protect,* etc.

Procedure: Ask the pupils if they have ever seen a bird like the one shown in the first picture and have them tell what they know about it. If the bird is unfamiliar to them, tell them it is a female quail. Explain that the quail is sometimes called a bobwhite, because of the call of the male bird. Have them note that the nest is made on the ground, where it is shielded by bushes. The nest is frequently built in tall grass, often drawn together above to form a protective canopy.

In studying the second picture, the children should note the number of eggs and their white color. Draw attention to the male bird shown in this picture, and discuss likenesses and differences in the plumage of the male and the female.

To lead the pupils to see that the babies are able to move about freely and are well covered with down as soon as they are hatched, have them study the third picture and then compare it with the picture of the baby goldfinches in the nest on page 18. Ask, "Do the baby quails look stronger than the baby goldfinches? Why? How is the body covering of the baby quails different from that of the baby goldfinches? How does having their nest on the ground help the young quails? How might it harm them?

"Look at the fourth picture. What are the babies doing now?" Elicit that the young birds have left the nest shortly after hatching, but are kept in a group and led by one or both of the parents. Point out how the adults protect the young and aid them in finding food.

Tell the pupils that in the fifth picture the babies are now three weeks old and ask, "Why isn't it necessary for the mother quail to cover her young ones with her body as the mother goldfinch does in the fourth picture on the opposite page?

"The last picture shows how the young quails protect themselves after they are three weeks old. How does sitting in a circle with their heads facing outward help the young quails? How many young males are there? How many females?"

Lead the children to see that these young birds, because of their ability to walk well almost immediately after hatching and to eat the food at hand, and because of their adequate

downy covering and the rapidity with which they develop the ability to fly, do not require so much protection or help in getting food as the baby goldfinches do.

Extending and Enriching Activity:

The children should tell of other birds, such as chickens, turkeys, geese, etc., which have adequate covering and are able to move about competently almost immediately at hatching. These should be compared with other common local birds, such as robins, bluebirds, wrens, etc., that are far more helpless at hatching. The children should compare the extent and length of care required by these fledglings for survival.

Page 20

Relation to the Unit: To present an example of a baby mammal that must be fed, sheltered, and protected from animals that may attack it.

Concepts:

A. Baby mammals when born cannot move about competently.
B. Baby mammals drink milk from the mother's body.
C. Baby mammals are protected by the mother until they are almost fully grown.
D. Baby mammals receive more parental care than the young of other animals.

Information for the Teacher: The young raccoons, from three to six in a litter, are born in April. The blind, helpless babies are carefully cared for by their parents, and the family remains together until fall. Raccoons feed on almost anything edible except herbage. They are especially fond of fish, which they are adept at catching with their front paws. These animals, with their amusing masked faces, have an interesting habit of washing their food carefully, even in dirty water, before they eat it. They nest in hollow trees, caves, or burrows, and are excellent tree climbers. An adult raccoon weighs about fifteen pounds and is about the size of a small dog. Raccoons are found only in North and Central America.

Procedure: Present the title "A Raccoon Protects Her Babies" and have the pupils interpret the picture sequence; then bring out through discussion the types of care the mother raccoon gives her babies, including food, shelter, transportation, and protection from animals that seek them for food. Ask, "Why can't the baby raccoons care for themselves?" Lead the pupils to see that they are unable to get about competently, that they cannot get suitable food for themselves, that their teeth are not well developed, and that their claws do not give them adequate protection against their enemies.

Extending and Enriching Activities:

1. If there are raccoons in the vicinity, ask the children to look for their tracks near the streams and then describe them to the class.
2. Visit a zoo and watch the eating habits of the raccoons.
3. Reëxamine pages 4-5 and 10 to find other young mammals and tell how they are like the raccoons.

Page 21

Relation to the Unit: To present an example of a baby bird that is competent to move about and get its own food but is not able to protect itself from its enemies.

Concepts:

A. Many baby birds can move about competently.
B. These baby birds eat the same types of food as the parents, rather than special types of food, and secure it themselves.
C. These baby birds cannot defend themselves and are protected by their parents.

Information for the Teacher: The Canada goose, the largest of our wild geese, measures from thirty-five to forty-three inches in length. The nests, which are made of sticks and lined with down, are found along the shores of streams. Only four or five eggs are laid, and both parents participate in the care of the young. The gander also bravely defends his nest and family from the attacks of all aggressors. He uses his great, powerful wings to beat off his assailant and his strong-toothed beak to give a vicious bite.

During the discussion develop such words as *goose*, *gander* (optional), *gosling*, *attack*, etc.

Procedure: Follow the same plan as that used on page 20 in presenting the title "Geese Protect Their Babies" and in having the children interpret the picture sequence. Lead them to

enumerate the various types of care given the young, the location and acquisition of food, and the protection afforded the young from animals that might attack them.

Have the children discuss, in the first picture, the care the mature geese are giving the babies. Then ask, "What care do you think the parents might have given the eggs before they were hatched?"

Call attention to the second picture, which shows one parent nudging the small ones into the water. Bring out the fact that, while the adults do not actually feed the goslings, they bring them to a place where the food may be found, and soon the little ones are diving for it.

Use the third picture to form a basis for a discussion on the protection of the young. Point out how the mother hovers over the goslings while the male assumes the active rôle of attacking the aggressor.

Have the pupils note in the fourth picture how the male seizes the fox by the ear and how he uses his powerful wings for combat purposes. Stress the amazing strength of the wings and the absolute fearlessness of the male, even though the fox appears to be a larger and more formidable animal.

Extending and Enriching Activities:

1. The goose is a much maligned creature of story and fable. Actually all varieties of geese, as well as the Canada goose, are brave and intrepid defenders of their mates and their young. Collect and read stories about the bravery of geese.
2. Compare the goslings with the young finches, and bobwhites (pages 18, 19) with regard to (a) extent and type of body covering shortly after hatching, (b) ability to move about competently shortly after hatching, (c) extent of parental help needed in feeding, and (d) parental protection required.

Page 22

Relation to the Unit: To review and summarize the need of certain baby animals for protection by their parents.

Information for the Teacher: The animals shown on this page are robin, lion cub, rabbits; colt, opossums, chipmunk; calf, bear cub, fawn; puppy, lamb, and leopard cub.

Procedure: Direct the children to look at all the pictures on the page; then ask, "Do all of these baby animals need protection? Why?" (The birds cannot fly from danger; the rabbits, opossums, puppy, chipmunk, and lion and leopard cubs cannot run rapidly enough to escape.) Point out that, while these baby animals are able to move with varying degrees of speed, none is swift enough to escape from the hungry animals that might attack it. Bring out the idea that all the animals shown are too weak to stand their ground alone and fight. Explain that, with such animals as the calf and the colt, care and protection are largely afforded by man, and that these animals do not normally meet the dangers they would encounter in an undomesticated state, although domesticated mammals unhesitatingly defend their young from danger.

In order to bring out the generalization that all the animals pictured need protection until they are sufficiently mature to fend for themselves, ask the class, "Why do all these animals need their parents to care for them?"

Page 23

Relation to the Unit: To present examples of baby animals that receive no protection or care from their parents.

Concepts:

A. Many baby animals that move about competently receive no protection from their parents.
B. Many baby animals that develop a hard, protective body covering receive no protection from their parents.
C. These animals eat the same kinds of food as their parents.

Information for the Teacher: A very few snakes bring forth their young alive, but since these are probably beyond the children's experience, they should not be mentioned.

The female alligator often remains in the general vicinity of the nest, but does not brood the eggs or protect the young.

Although the shells of turtles and snails at the time of hatching are not hard enough to give them protection from larger animals that prey on them, these shells later harden and become tough.

To permit ease of illustration, the nests pictured on this page are shown exposed to view. In reality the eggs are buried in the sand or earth or laid in a mound of grass and twigs.

Procedure: Direct the pupils' attention to the first picture and ask, "What kind of animal do you see in the first picture? What has just happened to the turtles?" Tell the pupils that the mothers of all the baby animals pictured on this page merely deposited their eggs and gave no protection either to the eggs or to the young after they were hatched. "What are the little turtles doing? What do you think they might be looking for? If an animal should try to eat them, what would they do?" Elicit that the young turtles would hide in the grass or dive into the water. Explain that countless numbers are eaten by animals preying on them, but that many will survive because the hatch is so extensive. When the shells have grown harder, they will serve as protection.

"What animals do you see in the second picture? What kind of animal do you think laid the eggs from which they were hatched? When the animals are full-grown, what will they be? How can you tell whether they will be frogs or toads without seeing either the mother or the eggs? What are the tadpoles doing? What do you think they are looking for? What will they do when danger threatens them?" The teacher should point up the discussion in such a way that the children will see how the speed and agility of the tadpoles help some escape from turtles or fish that may prey on them, but many are eaten.

"What do you see in the third picture? These young fish have just hatched. What are the little fish doing? How will they escape from their enemies?" Emphasize again the part that speed plays in their survival and the fact that many do not escape but are eaten.

Say, "In the fourth picture you see both eggs and little animals. What are these animals called? What has just happened to them? What do they do as soon as the egg breaks? What are they looking for? When they are older and their shells are hard, how can they escape from animals that would eat them?" Elicit that the snails will pull themselves into their shells and be safe. "Do you think they can move swiftly? Which of the four kinds of animals that we have talked about are the most alike?

"What do you see in the fifth picture? What are these animals doing? How do they get away from other animals that might attack them?" Lead the pupils to see that the snakes glide away rapidly.

"What are the animals in the last picture? What are they doing? How do they get away from animals that might attack them?" Lead the pupils to see that the alligators either hurry for the water or glide under nearby rocks and leaves.

"We have seen six kinds of baby animals on this page. Although they are very different, there are many ways in which they are alike. Let us see if we can list these ways." The children's responses should include the following points:

1. All of the animals were hatched.
2. In each case there were many eggs and many babies.
3. The tadpoles and minnows hide in the weeds and rocks when escaping from animals that prey upon them; so do the turtles, snails, and alligators until their body covering is thick enough to give them adequate protection.
4. The turtles, snails, and alligators develop hard, protective coverings.
5. The tadpoles, minnows, and snakes use speed when escaping from animals that prey upon them.
6. None of these animals was fed or protected by its parents.
7. None of them received milk from the mother's body.

Pages 24-25

Relation to the Unit: To review the importance of locomotion as a factor in food getting.

Information for the Teacher: This page may also be used to review the types of locomotion that were presented in *Look and Learn;* namely, that some animals fly, some swim, some crawl, some walk, some hop, and some move about in two or more ways.

The animals pictured on page 24 are Rhode Island Red chickens, pintail ducks; goldfinches, rainbow trout; red squirrels, painted turtles. Those pictured on page 25 are cats, turkeys; grasshoppers, snails; rabbits, red-winged blackbirds. (The male red-winged blackbird is shown in his first nesting plumage.)

Procedure: The children should, in each picture, compare the young with the adult, discuss the method of locomotion, and decide whether or not the baby animals at the stage pictured are able to move about competently enough to secure their own food. The children should then point out, on the basis of their findings, which young will need a greater degree of parental help in obtaining food. Their responses should bring out the fact that the young chickens, ducks, turkeys, trout, turtles, grasshoppers, and snails can move about almost as soon as hatched and hunt for food. (The children may recall from their own experiences and previous discussions that the parents of chicks, ducklings, turkeys, etc., usually give assistance in finding food at the early stages immediately after hatching; otherwise, the teacher should tell the children this.) The pupils' responses should also include the fact that the goldfinches, squirrels, kittens, rabbits, and red-winged blackbirds cannot move about efficiently and will have to be fed by the parents.

Extending and Enriching Activities:

1. Classify the baby animals in the picture collection as to ability to move about efficiently at the very early stages.
2. Review types of locomotion: walking, flying, swimming, etc., and find examples of each type.
3. Make up riddles about baby animals, using locomotion and its relation to food getting as the principal theme.

Pages 26-27

Relation to the Unit: To summarize the classification and grouping of many animals included on the preceding pages on the basis of varying factors.

Procedure: All the animals pictured on these pages have been presented on previous pages. Direct the children to look at all the pictures and ask them to find (1) animals that are fed milk from the mother's body (foxes and fawn), (2) animals that eat the same type of food as the parents but are not competent to move about and secure it for themselves (scarlet tanagers and robins), (3) animals that eat the same type of food as the parents and are able to get it for themselves but need to be protected from danger (goslings and chicken), (4) animals that receive no care from their parents (tadpoles, grasshopper, caterpillar, trout fry, turtle, and snail), (5) animals that change shape many times as they grow (tadpoles and caterpillar), (6) animals that are hatched (tadpoles, grasshopper, tanagers, caterpillar, trout fry, turtle, goslings, chicken, robins, and snail), (7) animals that are insects (grasshopper and caterpillar), (8) animals that are birds (scarlet tanagers, goslings, chicken, robins), (9) animals that are mammals (foxes and fawn), (10) animals that have a hard, tough covering (turtle and snail), and (11) animals that use speed for protection (tadpoles, grasshopper, and trout fry).

Page 28

Relation to the Unit: To check the pupils' understanding of the fundamental concepts of animal growth; to promote ability to observe accurately and to perceive the sequent nature of growth.

Information for the Teacher: The correct sequential order for arranging the pictures should be as follows: (1) the small cubs nursing, (2) the tigress carrying a cub in her mouth, (3) the tigress teaching the cubs to hunt, (4) the tigress with one half-grown cub, (5) the tiger, nearly full-grown, and (6) the adult tiger.

Procedure: Say to the children, "These six pictures tell the story of the growth of one young tiger in a litter. The pictures that are numbered 1 and 6 indicate the beginning and end of the picture-story sequence. Can you arrange the other pictures so that they will come in the right order?" Then ask the pupils to indicate the correct sequence for the pictures and cite evidence supporting their arrangement. For example, in the second picture the mother is carrying the cub, whereas in the third picture the cubs are walking with the mother.

UNIT 2 Getting Work Done

General Concepts

A. When things are moved, work is done.
B. We can move things with our own muscles.
C. We can use machines that we operate with our own muscles.
D. We can move things with animals.
E. We can move things with machines that have engines and motors.

Page 29

Relation to the Unit: To introduce the unit theme; to review the concept presented in *Look and Learn* that a machine is a device which aids us in getting work done.

Information for the Teacher: Listed as far as possible by rows, the articles pictured are as follows: broom, crowbar, ice pick, sickle, hand cultivator, garden trowel, spade, file; knife, pruning shears, mason's trowel; pliers, glass cutter, hammer; needle, wrench, rake, squeegee, mop, chisel; pitchfork, shears, scrub brush, screwdriver; brace and bit, rolling pin, putty knife, paint brush; egg beater, potato masher, ax, compass, plane; pocket knife, pick, saw, punch, hoe, electric iron, blacksmith's forceps.

Procedure: As the pupils look at the page, ask, "Is there anything on this page that you have ever seen before? Tell us about it. Where did you see it? What is it used for? Do you know how it works? Did you ever use one?" If any articles are unfamiliar, help the children identify them, or ask for volunteers to report to the class at the next meeting the names and uses of the articles in question.

Bring into the classroom some of the articles pictured and have individual pupils select one in order to show the class how it is used. If a child chooses scissors, for example, guide the demonstration by saying, "Tell us what scissors are used for. Show us what you do with them. Will scissors cut things all by themselves?" Responses should include the fact that we must use our own muscles to make the tools work. Then, holding up a picture on a magazine or newspaper page, ask, "Without scissors do you think you can remove this picture from the page? Try it." Then have the pupil cut a picture from another page and ask, "Which is the easier way? Which way gets the work done faster and better?" Continue in the same manner with other tools as long as interest and time permit.

After the demonstrations ask, "What do all these articles help us do?" When the pupils respond that the tools are used to do work, or to get work done, present the title "Getting Work Done" and tell them that the next part of the book will be about the way people get work done. Ask, "What general name can we give all the things pictured on this page?" Pupils who have used *Look and Learn* will probably say, "Machines." For those who have not, or who reply merely, "Tools," develop the generic term *machines*.

Pages 30-31

Relation to the Unit: To introduce concepts of the unit informally in a picture-story sequence.

Concepts: When things are moved, work is done; man uses different types of forces and machines to get work done; machines enable us to use our energy more efficiently.

Information for the Teacher: At this time it is advisable for children to get a preliminary idea of the term *energy*, which is one of the most important concepts in science. Energy, according to the scientist's definition, is the capacity to do work. We can do work (that is, we can move things); therefore we must have energy. This energy, which is stored in our muscles, we can call muscular energy. It is this energy that enables us to push or pull things, that is, exert a force. At this level, of course, we cannot fully develop the scientist's meaning of the term *energy*, but we can develop enough meaning so that the children can use the term with understanding.

Procedure: Before the pupils open their books, ask, "Did you ever hear someone say that he hasn't enough energy to do something? What does he mean? What do you mean when you say you have a lot of energy? Probably you mean that you can work hard, that is, that you can push the lawn mower for a long time or pull a heavy wagon for a long distance. You are able to push the lawn mower or pull the wagon because you have energy. Animals have energy too. Engines and motors have energy. That is why they are able to run machines."

Then ask, "Did you ever see a car that was stuck in the mud?" Encourage pupils to tell of their experiences. "Today we are going to look at pictures that show the trouble some people had getting their car out of a ditch." Distribute the books, present the title "Stuck in the Mud," and have the pupils interpret the picture sequence. They should note in the first picture the type of road, its narrowness and muddy condition. Ask, "What is apt to happen on such a road? What did happen in the next picture? Why is one back wheel lower than the other?"

In talking of the third picture, elicit that the man got out of the car to see how deeply it was stuck in the mud. Then say, "When he got out, the woman started the engine. What happened?" Lead the pupils to see that the mud flew, but the car did not move. "What makes the mud fly out in back?" Explain that the engine is running and turning the wheels, but that they are spinning around and around and the car is not moving forward.

Have the pupils note that in the fourth picture the farmer has left his hayrack and has come back to help. Ask, "What are the two men doing? Why do they stand at the sides of the car to push instead of at the back? What shows that the engine of the car is still running?"

Say, "The two men weren't able to push the car out, and so they tried something else. What do you think they are doing in the first picture on the next page?" Elicit that they are trying to put boards under the wheels to keep them from sinking farther into the mud and to give them something to grip.

Then say, "However, even when they backed the car over the planks, they still couldn't get it out of the ditch. What did they try next? Why do you think they thought the horses would be able to get it out?"

Have the children look at the next picture and then say, "What are they using now? Do you think the tractor will be able to move the car, though the horses failed? Why?"

Then ask, "What different things did the men do to try to move the car out of the ditch?" The pupils' responses should include the ideas that the people pushed, that they placed boards under the wheels, that they tried to pull the car with horses, and that they finally used a tractor. Develop through discussion the idea that the tractor was able to get the car out because it exerted more force. Develop also the idea that the car was moved from one place to another, and that this is what we mean when we say, "Work was done."

Extending and Enriching Activity:

If possible, have the children observe a tow car. They will be particularly interested in the cable, winch, and pulley arrangements that are used, and also the warning blinker lights, spotlights for night work, various tools, etc.

Page 32

Relation to the Unit: To show that many kinds of work are done by muscles.

Concepts:

A. Muscles help us push.
B. Muscles help us pull.

Information for the Teacher: During the discussion develop such words as *muscles*, *push*, *pull*, *lift*, *ramp*, *flex* (optional).

Procedure: Say to the pupils, "In the story on the two preceding pages we found out that, when something was moved from one place to another, work was done. Today we are going to see some other things that are being moved."

Distribute the books and present the title "Muscles." After the pupils have enjoyed the pictures, say, "What work is being done in the first picture? Why do you suppose the circus men used an elephant instead of doing the work themselves? How does the elephant move the wagon up the ramp?"

Ask, "What work is being done in the second picture? How are these men tightening the tent ropes? Could the circus men have used an elephant to do the same job? How?

"What work is being done in the third picture? In the pictures above the elephant is

pushing, and the men are pulling. Here the strong man is lifting. If you lifted a heavy book from the floor, would you pull or push?" If there is disagreement, make sure the pupils see that lifting up to the arm level is pulling, and after that it is pushing. Then say, "Is the strong man pushing or pulling?

"What work is being done in the fourth picture? What do the ponies do as they move the cart around the ring, push or pull?

"Does anyone know what parts of our bodies we use when we push or pull things?" Point to the title and say, "Do you know where any of the muscles in your own body are?" If some of the pupils are unable to give examples, direct someone to rise, walk across the floor, lift a book from a shelf, and bring it back. Elicit that muscles in the arms, legs, and hands were the principal ones used. Have the pupils feel muscles in the arms and legs as they are flexed. "Now look at the elephant again. What principal muscles do you think he is using? Is he using them to push or to pull?"

Continue with the other pictures, noting the contracted muscles in the arms, legs, and backs. At the close of the lesson help the pupils formulate the statement that we use muscles (voluntary) located in various parts of the body to push or to pull things.

Extending and Enriching Activities:

1. Have the children keep a list of their play and work activities during the day and list the principal voluntary muscles used.
2. If the pupils have listed the moving of loads in their activities, have them decide, through pulling and pushing, which is the easier way of moving loads, particularly of lifting them. *At no time should any child be permitted to overtax his strength.*

Page 33

Relation to the Unit: To show that machines which we operate with our own muscles make work easier.

Concepts:

A. Our muscles supply energy or force to move machines.
B. We use less force when we use a machine to help us do work.

Information for the Teacher: During the discussion develop such words as *weight*, *heavy*, *load*, *porter*, *baggage*, *ax*, *wheels*, etc.

Procedure: Say, "This page, called 'Machines and Muscles,' is divided into three parts, and each part shows the same work being done in two different ways. Look at the two pictures at the top of the page. What work is the woman doing in the first of these pictures? Yes, she is carrying groceries. She is also walking." If the children question the fact that walking is work, ask, "Didn't you ever get tired when you walked for a long time?" Then say, "What work was done in order to get the groceries into her arms? What work is the woman doing in the second picture?" (Walking and pushing the groceries in a wheeled basket.) "What is holding the groceries now? If the large basket did not have wheels on it, would it be as easy to move the basket? Why not? In which picture does the work look easier? Why?" Bring out the idea that in the first picture the woman has to move herself and the total weight of the groceries, while in the second picture the wheels support the weight of the groceries. Then say, "What name do we give things that help us do our work? Is the basket with wheels a machine? Why? In what other way is the machine helping the mother?

"Now look at the next row of pictures. What work is being done? Is the man using a machine in either of these two pictures? In which of these two pictures does the work look easier?" (No point need be made of the fact that through the use of the ax, force is more efficiently applied, since it is applied to a sharply defined and limited area.)

"What work is being done in the last two pictures? What work did the porter do before he got the baggage into his arms or into the truck? Is the porter using a machine in either of these pictures? In which picture does the work look easier? In which picture is the porter able to move more baggage? Why?" Again elicit that the wagon supports the load and that the wheels make it easy to move the load across the ground.

"Look at the six pictures on the page. Find the three that show the work being done easily. What are all the people using? When people use machines to help them, do they have to work as hard as they do when they have no machines?"

Extending and Enriching Activities:

1. Discuss some non-motor machines commonly used by children such as scissors, broom, wagon, etc. Discuss how each reduces the muscular energy required to do the work. Discuss whether the work could be done by muscles alone, eliciting that in many phases of modern life there is no feasible substitute for a machine; for example, a can cannot be successfully opened with muscles alone; cloth cannot be cut with muscles alone. Children usually enjoy listing activities that require the use of machines.
2. Recall the work done in activity 2 of the previous lesson. Discuss ways in which non-motor machines could have been used. Some pupils may be sufficiently familiar with the fixed pulley to suggest its use in lifting. If so, bring a small pulley to the classroom and demonstrate its use. Pupils familiar with the pulley may be able to deduce its presence in picture 2 on page 32.

Page 34

Relation to the Unit: To show that we can move things with animals.

Concepts:

A. To save our own energy, we often use the muscles of animals to get work done.
B. Many animals are stronger than man and thus are able to exert more force than man.
C. Man trains some kinds of animals so that they can be used to supply force for machines.

Procedure: Turn back to page 32 and say, "Why did the circus men use the elephant to push the wagon up the ramp? One elephant could push the wagon. Do you think one man could?" After their response that the elephant was stronger and could push harder, thus exerting more force, have them turn to page 34. Present the title "Machines and Animal Muscles." Say, "This page, also, shows three kinds of work being done. In which of the pictures in the top row is the man using his own muscles to make his machine go? We call making a machine go *operating* it. What is doing most of the work in operating the machine in the other picture? In which of the two pictures do you think the man will finish cultivating his cornfield more quickly? Why?" Responses should include the fact that, because a horse is stronger than a man, it can exert more force. This enables the farmer to save his own energy and use a machine that will cover more ground, thus getting more work done in a given time.

Continue with the second and third rows of pictures in the same way.

To help pupils make the generalization that to save our own energy we often use the muscles of animals to get work done, say, "Look at the six pictures on the page. Find the three that show the work being done easily. What are the people using? When people use the muscles of animals to operate machines, do they have to work as hard as when they use their own muscles to make the machines go?"

Extending and Enriching Activities:

1. Collect pictures that show various types of work being done by animals. The children should be encouraged to conclude that man's use of animals is generally limited to that of drawing loaded vehicles. This will lead naturally to later conclusions regarding the value of the wide variety of uses to which motor-driven machines can be put.
2. Refer to activity 2 for page 33 and decide whether any of the work listed could be more efficiently and easily done by the use of an animal. Thus, if the children have listed the use of a wagon to bring groceries home, they should point out that a goat or a pony could supply the force needed to pull the wagon.
3. Make careful observations regarding the use of animals in everyday work.
4. Pupils who have used *Look and Learn* should review the value of the wheel.

Page 35

Relation to the Unit: To show that we can move things with machines that have engines and motors.

Concepts:

A. Motors and engines supply energy to run machines.
B. Motors and engines use electricity or fuel as a source of energy.
C. Many motors and engines have greater power than human beings or animals and therefore can do heavier work.

D. Power-drawn or power-driven machines can do work faster than human beings.
E. Motors and engines must be operated by man.

Procedure: Say, "Look at the picture on the opposite page of the horse drawing the cultivator. Do you know anything else that the farmer might have used to pull the cultivator? Is a tractor a machine? How is it different from the cultivator?" Elicit that the tractor contains an engine that makes the machine go. Then ask, "Do you think that a tractor has more power than horses? Why? Might it pull the cultivator faster than the horses could?"

Present the title "Machines and Motors" and direct attention to the first picture on the page. Say, "Look at the two airplanes. Which one is the glider? How is the glider different from the bomber? Would you call both of these airplanes machines? Which one has engines? These engines need fuel to make them run. Do you know what the fuel is?" (Gasoline.) "Will the engine in the bomber start by itself or must it be started? Who starts the engine? We have said that the glider has no engine. Could it move and rise from the ground by itself? What makes it move and rise?" (Note: The glider, after it casts off the tow rope, is supported by the currents of air that flow past the wings.)

"Look at the second picture. How many machines are being used to remove the snow? With which machines are the men using only their own muscles? In which machine is there an engine? What kind of fuel do you think that the tractor uses? Will the tractor start and stop by itself? Who must do it? Which man will get the snow cleared away faster? Why?"

Continue with the third picture in a similar way. Conclude by saying, "The tractor, the airplane, and the snowplow use gasoline. What makes the clippers run?" (Electric current.)

Help the children generalize that (1) engine-driven machines usually reduce the muscular energy required to accomplish a task, (2) they make it possible to do more work in a given period of time, (3) they often permit the doing of work that could not be done by muscular energy alone, and (4) they must all be started and directed by man.

Extending and Enriching Activities:

1. Collect pictures and make models of various types of airplanes. While it is not advisable to introduce theory of flight, children at this level can perceive the relation between the size (weight implied) of aircraft and the number of motors and size (weight implied) of fuselage and wing area. Thus, the fighter plane usually has one motor and a relatively small wing spread, while the bomber and cargo plane usually have two or more motors and a large wing spread.
2. Refer to activity 2 for pages 33 and 34 and decide whether any of the work listed could be done more easily by an engine-powered machine. In most listings it will be apparent that motor power can usually replace animal power, and also that a motor-driven machine can often do work that cannot be done by animals. Thus, a truck with its motor can replace a horse-drawn cart, while a cargo plane can fly.
3. List the motor-driven machines (electric- or gasoline-powered) that are encountered in one day's activities. Tell how each contributed to the ease and speed of doing work.
4. Rural children should discuss understandingly the great importance of machines, motors, and engines to the progress of farm life: the more extensive acreage that a farmer can keep under cultivation, or the larger animal-husbandry programs he can undertake because of the introduction of tractors, planters, combines, milking machines, power shears, etc. City children probably lack sufficient background to understand the value of farm machines other than tractors.
5. If possible, arrange to visit a factory to determine what work is done entirely by human muscles, what is done by machines powered by human muscles, and what is done by motor-driven machines. Children should note the speed with which parts can be turned out if made largely by motor-driven machines rather than by hand.

Pages 36-37

Relation to the Unit: To expand knowledge of the use of machines and to compare and contrast different methods of getting work done.

Concept: Different types of force may be used to do the same work.

Information for the Teacher: The small pictures on page 36 show: man and pack mule,

automobile, man with horse-drawn drag; man with mule-drawn scraper, men lifting beams with derrick, man driving dog sled. Those on page 37 show: man using hand roller, man using horses to drag beam, man using caterpillar tractor to drag beam; cargo airplane, gasoline roller, gasoline shovel and dump truck.

Procedure: Direct attention to the four pictures at the top of the two pages, and during the pupils' interpretation stress the fact that in the first picture the men are moving themselves and a load from one place to another; in the second, they are digging a hole for a basement; in the third, they are moving a heavy steel beam; and in the fourth, the man is pounding down the earth before concrete is laid over it.

When the pupils have finished discussing the four large pictures, say, "Now look at the small pictures. What did we say the men were doing in the first big picture? Do you find any small pictures that show other ways in which people move from one place to another and carry loads? Can you find pictures in which the man does not have to do much work because animals are moving the load? Find pictures in which machines with engines carry the load. What makes the engines run?

"Do you find any small pictures that show other ways in which men might dig a hole for a foundation?

"Are there any small pictures that show other ways of moving the heavy beam?" In each case elicit the main source of energy.

"Do you find any small pictures that show other ways in which men could flatten or smooth the ground? Which of these pictures shows a man using only his own muscles to operate the machine? Which picture shows horses using their muscles? Does the man driving the horses use his muscles at all? Does the man operating the gasoline roller use his muscles at all?"

At the close of the lesson lead the children to formulate the generalization that many different forces and kinds of machines are used by men to get work done; and that, when men use a machine with an engine or a motor, they gain time and generally use less of their own energy in accomplishing a given task.

Extending and Enriching Activity:

Reëxamine pages 36-37 and discuss the time element involved in the various ways of doing work. Thus, the mountain climbers could eventually move as great a load as the cargo plane can, but this would take much more time and muscular energy.

Pages 38-39

Relation to the Unit: To summarize and dramatize the concepts that there are many ways of doing work; that machines save man's energy; and that engine-drawn machines can provide more power than an animal or a man can.

Procedure: Children who are unfamiliar with docks and wharves may need additional background or more detailed questions to interpret these pages, but all children should readily perceive that this busy scene depicts the loading and unloading of supplies and equipment.

Say, "What is this picture about? What do you think might be in those large packing boxes, barrels, and crates? Yes, there might be machinery, food, and all kinds of supplies. What is going to happen to these supplies?" Elicit that they are going to be shipped to various points. If the pupils have visited a factory as previously suggested, elicit that after goods have been manufactured, they must be distributed to the people who buy them.

"What ways of moving or shipping these supplies can you find? Yes, there are ships, trucks, trains, aircraft, horses and wagon. Do you know what we call the boat next to the train?" (A barge.) "What is the little tugboat doing? I am sure that the barge did not cross the ocean with its great waves. Can you tell why?" Elicit that the barge would fill up with water and sink in a heavy sea. "Can you find boats that could carry goods across the ocean?"

"Which way would you ship supplies if you wanted them to arrive very quickly? Would you use the trucks or the horses and wagon to move supplies the greater distance? Why?

"There are many ways in which men are working to load and unload the supplies. What work do you see them doing?" Elicit that some men are wheeling supplies on two-wheeled hand trucks, others are loading dollies (see foreground of page 39), some are loading and unloading trucks, others are operating winches and pulleys on the ship, etc.

"Can you see the man in the cab of the locomotive? He is not helping with the loading and the unloading. What work will he do? Does he

work as hard with his muscles as the men who are lifting the packing cases?

"Many of the loaders have machines to help them. Find the little train of loading cars next to the big red freighter. This is run by an electric motor in the first green car. What do you think the man in the green car does?" Elicit that he operates the motor. "See how big a load can be moved at one time by this little train. Can it carry a bigger load than the men can with their two-wheeled hand trucks?" (See left foreground, page 38.) "Can it pull as big a load as the train on page 39 can? Why not? Who works harder, the man who will drive the little electric train or the men pushing the two-wheeled hand trucks? Which can carry more at one time, the man with a hand truck or the man carrying the box on his shoulder?" (See right foreground, page 39.) "Are there any boxes in the picture that look far too big and heavy for the man to carry on his shoulder? How are they being moved? Do you know why the man rolls the barrel instead of carrying it?"

Tell the children to find the machines that have engines. (It is not necessary that the children name the electric truck in the center foreground, but they should name the ships, the tugboat, the delivery trucks, the train, the electric loading train, the cargo plane, the cranes, and the dirigible.) Ask, "Will these machines do work by themselves? Who must drive them and start and stop them?

"Of all the work being done on these pages, what would you like to do best? Why? How much would you have to use your muscles to do the work that you like best? Find men who must use their muscles a great deal to do their work. Find men who use their muscles less because they have machines to help them. Which will use their muscles more, those whose machines have engines or those whose machines have no engines?"

Extending and Enriching Activity:

If possible, take the children on an exploratory trip to any busy place—docks, railroad freight yard, wholesale food market, grain elevator, etc.—and have them observe first-hand the work being done, machines being used, etc. Conduct the discussion along the lines suggested in the lesson plan above.

Page 40

Relation to the Unit: To check the pupils' understanding of the concepts presented in the unit.

Procedure: Each row of pictures presents examples of ways of moving from one place to another. The pupils are to examine each row and decide which method requires the greatest expenditure of human muscular energy, which requires less, and which requires the least. The pupils should also select the quickest method of getting from one place to another and should perceive that with motor-driven machines greater distances can be covered in a given period of time.

Extending and Enriching Activities:

1. Arrange or draw similar pictures to show the efficiency of methods of getting from place to place. The pupils should justify their arrangement.
2. Cut out or draw pictures of other types of work being done by human muscles alone, animal muscles alone, machines plus human muscular energy, machines plus animal muscular energy, machines plus motors. Arrange on the basis of ease in accomplishing the work, speed in completing a given task, and amount of work possible in a given time.

UNIT 3 Sun, Wind, and Weather

General Concepts

A. There are many kinds of weather.
B. The sun appears to rise in the morning, describe an arc overhead, and set in the evening.
C. The sun gives us light and heat.
D. Temperature is an important factor in determining what the weather will be and thus affects our daily activities.
E. The wind has force.

Page 41

Relation to the Unit: To promote discussion of the different aspects of weather and weather changes; to provide opportunity for the teacher to explore the pupils' background and familiarity with terms used in describing weather.

Concept: Many different elements make up weather.

Procedure: Display the picture, tell the pupils that it is the title page for the next unit, and ask them what they think the unit will be about. Then present the title "Sun, Wind, and Weather" and discuss the picture in detail. Elicit that the picture presents a partially cloudy day, a warm day, a windy day, a partially sunny day, perhaps a midsummer day (certainly not a fall or winter day). Have the children cite evidence from the picture to justify their answers. Note the vocabulary they use in describing the weather conditions.

Pages 42-43

Relation to the Unit: To present in story form the aspects of weather combinations and their effects upon animal and human activities; to review weather concepts developed in *Look and Learn.*

Concepts:

A. Sun, moisture, temperature, and wind are elements of weather.
B. Weather combinations vary.
C. Weather changes may take place rapidly.
D. Weather changes can often be predicted from the condition of the sky.

Procedure: Present the title "A Day for Ducks" and allow the pupils to enjoy the picture sequence. Then discuss the pictures in turn. In the first picture of the series have the pupils discuss the type of farm activities that go on during a pleasant, sunny day and the different animals, farm buildings, and equipment shown. Then have the pupils describe the kind of weather portrayed in the picture, the early spring season, the absence of wind, the absence of clouds, the probable warmth, etc.

In the second picture the children should describe the elements of weather portrayed, telling how they differ from those in the first picture, pointing out everything that indicates that the weather has changed, and predicting other probable changes to come.

In the third picture the pupils should again describe the kind of weather shown, the signs which indicate that it will probably rain soon, the reasons why the farmer is rushing the sheep to shelter, why his wife is putting the chickens in the coop, and why there is no sunshine.

In the fourth picture the pupils should discuss the weather shown and the fact that some farm animals like and do well in wet weather. After the four pictures have been studied in sequence, have the pupils characterize each picture briefly in terms of sun, moisture, wind, and temperature. Conclude the lesson by asking, "How has the weather changed during the day? Have you seen weather like this? How can you tell what weather will be like during the day?"

Extending and Enriching Activities:

1. Have the pupils tell stories about their "weather" adventures, such as a picnic spoiled by a sudden rainstorm, etc.
2. Keep a weather chart. The chart on page 47 of *Look and Learn* indicates one feasible way of representing weather changes pic-

torially. The teacher may find, however, that children at this level are capable of more complex description and wish to add text or other pictorial information. The weather chart should be arranged so that information regarding temperature can be added during the work on pages 48-53.

3. Collect pictures about and discuss ways in which weather changes affect human activities and dress, and also animal activities.

Page 44

Relation to the Unit: To show that the sun appears to rise in the morning, describe an arc overhead, and set in the evening; to show that the sun gives light.

Concepts:

A. The amount of light we get from the sun depends upon how high the sun is in the sky.
B. Shadows change in length and position according to the position of the sun in the sky.
C. When we receive no sunlight, it is night.
D. The apparent movement of the sun divides the day into time intervals.

Information for the Teacher: The expression "apparent movement" of the sun is used because, of course, the sun itself does not move. Since the earth rotates from west to east, the eastern part of any region is the first to get to the point where the sun is visible. Thus it appears that the sun is rising in the east. These concepts should not be presented at this time.

Procedure: Present the title "Sun Time" and say to the pupils, "Although all of these pictures show the same place on the same day, each picture, in which you are supposed to be looking south, is different from the others because the pictures were painted at different times in the day. The first picture was painted just before the sun came up. Do you know what we call that time of day?" (*Dawn, sunrise, daybreak* are all acceptable answers.) "The second picture was made in the middle of the morning or in the forenoon. How is it different from the sunrise picture?" After the response that the sun is up in the second picture, ask, "Is there more light outside at this time of day? Why? How have the colors of things changed now that the sun is up? What do you see in this picture that you did not see in the sunrise picture?" (Shadows) "Why are there no shadows in the sunrise picture? The third picture was painted at noon. What differences do you see between it and the second picture?" Responses should include the ideas that the sun is almost overhead and consequently does not show in the picture, that the colors are brighter, the light is stronger, and the shadows are shorter. Ask, "What differences do you see between the third and fourth pictures? What time do you think it is in the fourth picture? Is the shadow of the tree in the afternoon picture in the same place as it was in the noon picture? The next picture was made just before sunset. What differences do you see between the afternoon and the just-before-sunset pictures? How is the last picture different from all the others? What time is it now? What has happened?"

Following the picture interpretation, quickly review the common time divisions of the day by directing the pupils to point out the pictures that show noon, night, sunrise, etc.

Then ask, "What do the pictures show about the change in the position of the sun in the sky?" (In the morning it was low in the sky; then it appeared to rise; at noon it was overhead; at dusk it was far down in the sky.) "Where was the sun in the sky when it made the shortest shadows? What changes took place in the shadows from morning until night? When the shadows were shortest, what time was it? How do the pictures show that the amount of light that the sun gives us changes? When does the sun give us the most light? When does it give us no light?"

After all the comparisons have been made, review the names of the time intervals shown.

Extending and Enriching Activities:

1. Have the children make a shadow stick by driving a nail about three inches long near one side of a square board. Place the board so that the nail will be at the southern side and put it in a place where the sun will shine on it all day. Then mark the shadows at 9 o'clock in the morning, at 12 o'clock noon, and at 3 o'clock in the afternoon.
2. Tell the pupils to observe the flagpole shadow at different times of the day.
3. Suggest that they observe their own shadows in the morning, at noon, and in the afternoon.

4. Draw pictures to show what happens to the shadow of some local or school landmark during the day.
5. On the first cloudy day have the children notice what happens to shadows. Explain that the clouds cut off some of the sun's light, and that the shadows become dimmer or disappear entirely.
6. Be sure that the children understand how shadows are formed. Flash a spotlight or flashlight on the wall in a darkened room. Then interpose small common solid objects between the source of light and the solid objects. Elicit that the solid objects cut off the light so that it does not shine on the wall, and thus silhouettes of the objects remain.
7. Children enjoy making shadow pictures with their hands—dog's head, goose, etc. During this play activity review the causes of shadows.

Page 45

Relation to the Unit: To determine the pupils' understanding of the concepts developed in the preceding lesson.

Procedure: Present the title "Do Shadows Help Tell Time?" and then say, "The man in the first picture is starting off to work. It is early morning. What can you tell about the early morning picture? Can you find a picture on page 44 in which the shadows are in about the same position?

"Now look at the second picture on page 45. Why do you think the dog is looking down the street? About what time of day is it now?" (Noon.) "Do you think the man will come home for dinner? Why not? How are the shadows in this picture different from those in the first picture? In what picture on page 44 do the shadows have about the same position as they do in the second picture on page 45?

"Now look at the third picture. How do the shadows look now? About what time do you think it is? Is there a picture on the opposite page in which the shadows have about the same position?

"About what time do you think it is in the last picture? How are the shadows in this picture different from those in the third picture? Find the picture on the opposite page that shows shadows in about the same position."

Then direct the pupils to look at the tree trunk, the grass, the walls of the houses, and roofs. Ask, "Can you think of any reason why these things look different in each picture?" Elicit that, when the light shines directly upon these things, the colors appear to be brighter.

The children should again formulate the generalization that the shorter the shadows, the higher the sun is in the sky, and that the longer the shadows, the lower the sun is in the sky. The pupils should also note that when shadows are shortest, it is noon, and that when they are longest, it is either early morning or late afternoon, depending upon the position of the sun.

Extending and Enriching Activities:

1. If the children have evidenced interest in the shadow stick previously suggested, they may enjoy marking off the hour intervals and making a shadow clock.
2. Tell the children about the sundials used in early days for telling time. If there is a sundial in a nearby garden, the children may observe it and compare it with their own shadow clock.

Page 46

Relation to the Unit: To present in story sequence the concept that the sun gives us heat.

Concepts:

A. The amount of heat received from the sun varies with the time of day.
B. Temperature is important in determining our daily activities.

Procedure: Distribute the books and present the title "On and Off." Tell the pupils that in the first picture it is about eight-thirty in the morning and that the little boy is starting for school. Then ask, "What is he doing? Why is he doing this?" Elicit that, when he got outside, he found the weather was too cool for just a sweater.

"In the forenoon at recess time the boy wore his coat outdoors, but he took off his coat before he began to play. Why?

"What do you notice about the length of the shadows in the third picture? What time do you thinks it is? What do you notice about the colors of the house in this picture as compared with those in the first picture? What is the boy doing with his coat now? Why?

"In the fourth picture the boy has finished his lunch and is on his way back to school. Why didn't he wear his coat or bring it with him?

"About what time do you think it is in the fifth picture? What are the children doing that would help you know what time it is? How do the shadows tell you that it is no longer noon? How are the shadows in this picture like those in the second picture? How are they different? When the boy came out to play this time he didn't put on his sweater. Why do you think he left it in the cloakroom?

"What has he done with his coat in the last picture? Why? What time of day do you think it is now? What makes you think so?"

In the summary lead the pupils to note that, as the sun got higher in the sky, the temperature became warmer and that the warmest part of the day came in the early part of the afternoon. As night approaches, the temperature usually becomes lower.

Extending and Enriching Activity:

Have the children tell how temperature changes during the day (not from day to day) affect people's dress and people's and animals' activities. The children may point out the adjustment of clothing to temperature changes, the tendency of many animals to avoid the heat of summer noons and afternoons by standing in the shade, etc.

Page 47

Relation to the Unit: To develop the idea that the amount of heat we receive from the sun is affected by various conditions.

Concepts:

A. It is warmer when the sun is shining than when it is night.
B. When clouds come between us and the sun, some of the sun's heat is cut off.
C. During the day it is warmer in the sun than in the shade.

Procedure: Present the title "Which Is Warmer?" Then say, "Look at the pictures in the top row. In which of these pictures would the boy on the opposite page be more likely to have on a sweater or a coat? Why?" Responses should include the fact that he would probably wear a coat in the night picture, since the sun gives heat, and the sun does not shine at night.

"In the second row we see pictures taken at the same time of day on two different days. In which picture do you think it is cooler? Why?" Pupil responses should indicate that they note that clouds have come between the earth and the sun; thus not so much direct sunlight nor heat will be present.

"Now look at the last row of pictures. In which one is the boy in the sunshine? How can you tell?" (His shadow is visible in the first picture.) "In which picture do you think he is cooler? Why?" Responses should include the fact that it is cooler in the shade than in the sunshine.

To lead pupils to generalize that the time of day, clouds, and shade affect the amount of heat we get from the sun, say, "We know that the sun gives us heat, but what things can cut off part of the sun's heat?"

Extending and Enriching Activity:

If any question has been raised about which is the correct picture in each pair, have the children duplicate the situations and decide about the relative amounts of heat. The discussion may be used as a natural lead into the subsequent work on the thermometer.

Pages 48-49

Relation to the Unit: To show that a thermometer registers changes in temperature.

Concepts:

A. When the liquid in the thermometer goes up, it is getting hotter.
B. When the liquid in the thermometer goes down, it is getting colder.

Information for the Teacher: On this page the pupils are introduced to the value and technique of experimentation. Consequently, great care should be taken to develop, in addition to the lesson concepts, the correct procedures in performing an experiment. The pupils should understand that the little girl has a question to which she is trying to find a definite and accurate answer. She assembles the materials needed; she follows a planned procedure with those materials; she observes the results and from her observations draws a conclusion that answers her question.

Most pupils can perceive, through this and subsequent experimentation pages in *All Around Us*, that it is possible not only to find the answer to a question but also to test it; and that if the conditions, procedures, and materials of an experiment are exactly duplicated, the results obtained will always be the same.

Before beginning these pages, obtain an inexpensive thermometer similar to that shown (two thermometers are needed if there is no room thermometer) and the other materials shown.

The water shown in picture 1 on page 49 is not boiling water. What we call "steam" is shown in order to represent heat pictorially. Do not use boiling water in the classroom experiment.

In most schools, pages 48 and 49 will be taken up on different days. For this reason they are presented in such a way that each page is a learning unit, even though both pages should be completed before the full answer is given to the question.

During the discussion develop such words as *thermometer*, *temperature*, *experiment*, *question*, *answer*, *test*, *heat*, *liquid*, etc.

Procedure: Introduce the classroom thermometer for discussion by saying, "Sometimes we feel that our room is too hot or too cold, but before I ask the engineer to make the room warmer or cut down the heat, I usually walk over here and look at this." Point out the room thermometer. "What is this thing called?" If the children do not know, tell them. "Why do I look at the thermometer? What does it tell me?" Elicit that the thermometer tells how warm the air in the room is.

Have the children look again at page 47. Say, "Which of the first two pictures showed a warmer time of day? When we answered that question, all we could say was that it was probably warmer in the second picture than in the first. What could we have used to tell us just how warm it was?" Elicit or tell the children that a thermometer could be used because it measures temperature just as a ruler measures size.

Say, "Here is a thermometer we can look at easily. It works just the same way that the room thermometer does. What can you tell about it?" Elicit that there are numbers on the backboard, a glass tube fastened to the backboard, a bulb and a red (or silver) line. Say, "The glass tube is not solid; it is hollow, and the red you see is red liquid. It is not water, but it can be poured as water can. Where is the top of the red line? What number is it near? Yes, it is near the number 70. So the red line tells us that it is 70 in our room. Seventy is a healthful temperature, and our room is not too hot or too cold."

Have the pupils turn to page 48. Say, "These children have a thermometer, too. They are finding out some things about thermometers." Read the title "How Does a Thermometer Work?" and elicit that the children are going to find the answer to the question. During the picture study and discussion, elicit (1) the materials used, (2) the room temperature shown in picture 2 and its similarity to that of the pupils' classroom, (3) what was done with the materials, and (4) what happened to the liquid in the thermometer. Compare the height of this liquid with the height of the liquid in picture 2.

Say, "This little girl can give part of the answer to the question 'How does a thermometer work?' What did she find out?" Elicit that the girl found out that the liquid in the thermometer fell as it got colder. "We could do this experiment, too, and find out for ourselves if the girl was right. What materials do we need to do this experiment just as the girl did? Exactly how will we do the experiment?" Be sure that the pupils have the problem, the materials, and the procedure firmly in mind. Duplicate the experiment and compare the results.

"What number is the top of the red line nearest now? How do we know the liquid went down when it got cold?

"When we did just what the girl did, we got the same answer. Would we get the same answer if we did the experiment again? How can we be sure? What could we use besides ice to make it cold in this experiment?" Elicit that cold water or snow could be used. Repeat the experiment with cold water, and also with snow if the season permits. Encourage the children to comment on the relative drops in temperature, but be sure they make the generalization that the liquid in the thermometer falls as it gets cold.

Continue in the same way with page 49, presenting the title "What Happens?" Pupils should note that the procedures and materials are shown but that the results are not. The children should formulate the problems to be solved. These should be equivalent to "What

happens to the liquid in the thermometer when it gets hot?" (pictures 1 and 2) and "What happens to the liquid in the thermometer when the thermometer is moved from a sunny place to a shady place?" (Pictures 3 and 4.) Perform both experiments. When the second is completed, say, "We know that it is usually warmer in the sunshine than in the shade. How did moving the thermometer tell us that we are right?"

Pages 50-51

Relation to the Unit: To show how the temperature at various seasons of the year affects what we do and what we wear.

Concept: The amount of heat received from the sun varies with the time of year.

Procedure: Direct a pupil to look at the room thermometer, or elicit that 70 is the average room temperature in cold weather. Then say, "Look at the three thermometers on page 50. Does the top thermometer show a higher or lower reading than the one in our room? What is the temperature? What temperature does the second thermometer show? What temperature does the third thermometer show? What things would you expect people to be doing when it is 90? Look at the pictures and find those in which you think the temperature would be about 90. How are the people dressed? Why?

"How would people dress when the thermometer shows 20? What things would they be doing? Which pictures do you think show this temperature?

"During which seasons of the year would you expect to find a temperature of 55? What would you expect to find people doing? Which of the pictures show people dressed as they would be for this temperature? What are these people doing?"

Have the pupils find all the pictures that show spring, summer, fall, and winter. To help the children generalize that the amount of heat received from the sun varies with the season of the year, ask, "In what season is it likely to be coldest outdoors? When is it the warmest? What seasons are likely to have medium or in-between temperatures?"

Extending and Enriching Activities:

1. The teacher should secure an outside thermometer and have it hung outside the classroom window so that the children will be able to watch the temperatures each day.
2. Add temperature readings to the weather chart the children are keeping.
3. Take thermometer readings at different times of the day to get an idea of daily temperature ranges.
4. Take thermometer readings during sudden weather changes.
5. Have the children turn back to page 46. Have them take thermometer readings at the times indicated: time to go to school, morning recess, noon, afternoon recess, and evening, so that they can interpret the picture sequence in terms of actual temperature. Lead the children to see that with thermometer readings they are now able to give far more accurate weather reports.
6. Cut from magazines pictures of various outdoor human activities and types of clothing. On large charts draw duplicates of the three thermometers shown on page 50 and then paste the cutouts under the correct thermometers.
7. When temperature recordings have been made over a period of time, the children should make deductions regarding prevalent temperature trends in their locality: the highest temperature of the month, the lowest, the range, the average. (Most children do not have sufficient background in mathematics at this level to find an average, but they can be led to note the temperature readings that occurred most often during a given time period.)

Pages 52-53

Relation to the Unit: To extend the idea of the relationship between our activities and the temperature; to check the pupils' ability to see causal relationships.

Concepts:

A. Thermometer recordings indicate to us the kind of clothing to wear.
B. Thermometer recordings influence our control of the heat in our houses.
C. Thermometer recordings tell us when to protect growing plants.

Procedure: "There are two pairs of pictures on each of these pages. The title on each page is

'Why?' Look at the first pair at the top of page 52. What is the woman doing? What is she doing in the second picture? Why did she make the boy wear his warm coat?" Ask questions at this point which will lead children to the generalization that protective clothing is necessary before going out in cold weather.

"Look at the next pair of pictures. What is the man doing in the second picture? Why? Do you think the temperature was above or below 70? Why do you think so? What happens if we stay in a cold room for a long time? What happened to the liquid in the thermometer soon after the man put the coal in the furnace? What experiment did we do that helped you answer?"

"Look at the two pictures at the top of page 53. Do you think that the temperature in the room in the first picture is above or below 70? Why? In the second picture what is the woman doing to make the room cooler? What is the boy doing?

"Now look at the last set of pictures. When the man looked at the thermometer, was it above or below 70?" (The pupils probably have a general idea of the position of the liquid in a reading of 70. If not, have them consult their own thermometer.) "What is he doing in the next picture? Why did he protect the tomatoes when he found that the temperature was quite far below 70? What do we often have in spring and autumn when the temperature falls suddenly?" Elicit that we often have frost.

To summarize the importance of thermometers in our daily lives, say, "On these two pages we have seen people looking at thermometers to find out what the temperature is. How does the thermometer help them decide what to wear and what to do?"

Extending and Enriching Activities:

1. Have the children note the relationship between the temperature and the kind of clothing they wear.
2. Play "games" in which deductions are made regarding behavior influenced by temperature. Thus, one child might say, "Last week I bought some baby chicks and put them in the new henhouse. The thermometer said 50 last night. Before I went to bed, did I light the heater in the henhouse, did I open the window, or did I leave the henhouse the way it was?"

Page 54

Relation to the Unit: To introduce, through a picture-story, wind as one of the factors that compose weather.

Concept: The wind has force.

Procedure: Read the title "A Surprise!" and allow the pupils to enjoy the picture sequence. Then say, "In this story the wind was not a very good friend to the children because it spoiled their party. They were surprised when the wind blew their tent away, but I don't think they should have been. What things do you notice in the second picture that tell you the wind is beginning to blow?" The children's responses should include the slight movement of the sheet and the girl's dress and hair. "Look at the third picture. What tells you the wind is beginning to blow harder?" The children should note the billowing sheet and the rolling clouds. "How do you know the wind is blowing still harder in the next picture?"

Extending and Enriching Activities:

1. Tell other humorous stories about wind action.
2. Tell about, or collect pictures of, toys and equipment that depend upon wind action for successful operation. These might include a pinwheel, a kite, a windmill, a glider (gliders maintain flight upon air currents, of course, but this distinction need not be made), a balloon, a sailboat, an iceboat, etc.

Page 55

Relation to the Unit: To develop the ability to make inferences regarding the force of the wind from observable data.

Concepts:

A. The force of the wind varies.
B. The force of the wind may be told by the effects it produces.

Procedure: The pupils are to examine the sets of pictures in each row, realize that the wind is blowing in both pictures, select the picture in each set that shows the stronger wind, and justify their answers.

After presenting the title "How Strong Is the Wind?" say, "The wind is blowing in every picture on the page. Look at the first picture. How

can you tell that the wind is blowing? Can you tell by looking at the cornstalks? Are the treetops in the picture bent over? Would it take a stronger wind to bend the treetops than to bend young corn? Why? Is the wind stronger or weaker in the second picture?

"Look at the next pair of pictures. How do you know the wind is blowing in both pictures? In which is the wind blowing harder? How can you tell?" Call attention to the billowing sail, the tipping of the boat, the waves, etc. Children who are familiar with sailing may call attention to the fact that the mainsail has been lowered to keep the boat from swamping. "In which picture is there likely to be a storm and a still greater wind? How do you know?

"Look at the last pair of pictures. How do you know the wind is blowing in each of these pictures? In which picture is it blowing harder? How can you tell it is not blowing very hard in the second picture?

"Sometimes we say that wind is a friend to people because it helps them. We have talked about ways in which people use wind to help them." Discuss again activity 2 (page 54). "Sometimes wind is an enemy to people because it causes damage. Was the wind an enemy or a helper in the story on page 54? Find a picture on page 55 in which wind is being an enemy." (Picture 5.) "Find a picture in which the wind may become an enemy." Elicit that the man in the sailboat in picture 3 is actually pitting his skill as a sailor against the wind.

Pages 56-57

Relation to the Unit: To show that the force of the wind determines its usefulness to man.

Concepts:

A. Man uses wind force to his advantage.
B. The wind may be man's enemy.

Procedure: Read the captions at the left-hand side of page 56 and then direct the pupils to examine each picture, describe what is happening, and tell whether the force of the wind is helping or harming the people or property in the picture.

Ask, "In which pictures does the wind appear to be blowing gently? In which pictures does it appear to be blowing very hard? Point out in as many pictures as you can find on these two pages the ways in which it does harm. Point out in as many pictures as you can find the ways in which wind may help people. We told about ways in which wind is used by people. Did we name any that are not shown in the pictures? Are any shown that we did not name?"

Page 58

Relation to the Unit: To show that temperature is an important factor in helping us predict what type of wet weather clouds may bring.

Concepts:

A. We have different kinds of wet weather: rain, snow, sleet, and fog.
B. The temperature of the air helps us know whether clouds will bring rain or snow.

Procedure: Present the title "Storm Clouds." Then say, "Look at the first pair of pictures on the page. What season do you think it is? What kind of sky do you see? The temperature in both pictures is the same. What does the thermometer tell you about the temperature? Is it just about as warm as it is in our room?" Be sure that the children understand the warmness indicated by the reading. "Now look at the picture at the right. What kind of weather did the storm clouds bring?

"Look at the next pair of pictures. How is the first picture like the one just above it?" Elicit that both show the same season. "What does the thermometer show about the temperature in the second pair of pictures? What kind of wet weather did the storm clouds bring when the temperature was this low? What did the temperature have to do with the kind of wet weather in the second picture?"

To lead the pupils to generalize that the temperature of the air helps us know whether clouds will bring rain or snow, ask, "When the temperature of the air is warm and there are heavy clouds in the sky, what kind of wet weather do we usually have? What kind of wet weather do the clouds bring when the temperature is cold?"

Extending and Enriching Activities:

1. Make morning sky, wind, and temperature observations and predict the weather for the later part of the day. Note the relation between temperature and type of precipitation.
2. Tell riddles and play games in which the elements of weather, particularly tempera-

ture, are important factors. For example, a child might say, "My father looked out the window before he drove to work. He decided there might be a storm, and so he put chains in the back seat of the car, where they would be handy. Why did he take chains with him? Where do you think the red line in our thermometer was?"

Page 59

Relation to the Unit: To show that changes in temperature bring about changes in weather conditions; to develop ability to make inferences.

Concepts:

A. Rain may freeze and cover the ground with ice when the temperature falls.
B. Snow melts when the temperature rises sufficiently.

Procedure: Present the title "What Happened?" and tell the pupils that the pictures in each row show the same place at different times during the same day. Direct them to look at the first picture, note the temperature, and then look at the picture at the right, which shows the same scene several hours later. Say, "What is happening in the first picture? Is it a warm, rainy day as it was in the second picture on page 58? How do you know it isn't? Do you think the people have their furnace fires going? Yes, it is a cold, unpleasant, rainy day. It would not be fun to be outdoors.

"Now look at the next picture. What differences do you see in this picture? Was there a change in the weather? Why does the little thermometer have a question mark over it? Was there a change in the temperature? How do you know? Did the liquid in the thermometer go up or down?"

Continue with the same procedure for the next row of pictures.

Extending and Enriching Activities:

1. Tell riddles, compare pictures, etc., to give additional practice in the type of deduction required on page 59.
2. Observe sudden weather changes and guess whether changes will take place in the thermometer readings. Verify in each case by reading the thermometer.

Page 60

Relation to the Unit: To review the concepts presented in the unit.

Procedure: Direct the pupils to study the pictures and then to describe each one in terms of weather. These descriptions should be as detailed as possible, and the pupils should decide whether each picture allows them to draw conclusions about approximate temperature, season, type of wet weather, amount of sunlight, force of wind, clouds, and whether the wind is functioning as an enemy or as a helper.

Extending and Enriching Activities:

1. Using the pictures collected for previous activities, summarize the concepts of the unit. Thus, the children might group the pictures according to the weather conditions shown, approximate temperature readings, weather conditions common to each season, wind action, human activities and dress in relation to weather, etc.
2. If the children's interest warrants, continue recording weather reports on the weather chart. Otherwise, have them summarize what the chart has indicated about the weather: temperature range within a day, temperature range from day to day, highest and lowest temperatures for the month, average temperature for the month, extent and amount of precipitation, number of sunny warm days, number of sunny cool days, etc. The children should generalize that weather changes from day to day; that weather changes occur within a day; that temperatures follow a trend within a season, but may vary sharply from that trend and vary during the day; that clouds often indicate rain or snow; etc.

UNIT 4 Plants

General Concepts

A. Livings things have certain characteristics that distinguish them from non-living things.
B. Plants have distinguishing features by which we can tell one plant from another.
C. Plants grow and reproduce their kind.
D. Sufficient light and water are necessary for growth.

Page 61

Relation to the Unit: To introduce the unit theme and to explore the pupils' knowledge of the types and parts of plants.

Procedure: Have the pupils look at the page. Then ask, "Do you know the name of these plants? Have you seen any like them? Where were they growing? Were the flowers the same color as these? What parts of the plant do you see in the picture?" The response should include the stems, leaves, buds, flowers, and seed pods. "What are these plants climbing on? What would happen if there were no fence there for the plants to climb on? What general name do we give to plants that climb?" The pupils who have had *Look and Learn* will say "vines."

"The next part of our book has a story about morning-glories and how they grow." Present the title "Plants" and say, "This part of our book will tell us about other plants, too."

Pages 62-63

Relation to the Unit: To extend the concept presented in *Look and Learn* that living things have certain characteristics that distinguish them from non-living things.

Concepts:

A. Animals are living things.
B. Plants are living things.
C. All living things grow, reproduce, and die.

Information for the Teacher: Things that are alive are distinguished from things that are not alive in the following ways: they eat, grow, breathe, move, produce others like themselves, and die. The meanings most second-grade pupils attach to *eat*, *breathe*, and *move* are swallow, take air into and expel it from the lungs, and go from place to place. Plants use oxygen and food, too, but the children do not realize this fact. There are also some animals, such as the oyster and the sea anemone, that do not move about except when they are young and free-swimming; but there is no need to bring out exceptions to the general rule at this level. For the purpose of this lesson it is satisfactory to say that all living things are alike in that they grow, reproduce, and die.

Procedure: Present the title "Which Ones Are Alive?" Then, if the classroom has an aquarium, use it and follow the general pattern of the lesson below. If not, use the pictured aquarium in the following way: "Look at the picture at the top of page 62. Which things in the picture are alive? Which are not? Why do you say that the fish are alive?" If this question does not get a response, say, "What can the fish and the snail do that the stones, the sand, and the aquarium itself cannot do?" If the pupils do not include some expression for *reproduce* in their responses, have them turn to the first part of the book, look through the pictures, and note all the baby animals. The pupils will undoubtedly give many characteristics of living things, but emphasis should be placed on growth, reproduction, and death. Say, "How do you know that the plants are alive?"

Now say, "Look at the small pictures on both pages. We are going to make a chart to show how we know whether or not the things pictured on these pages are alive, but first we must answer the same questions about all of them. Do scissors grow? Do they make others like themselves? Do they die?" Continue in the same way with the other pictures.

On the blackboard the teacher may make a chart similar to the following as the children enumerate the things pictured on these pages.

	Does it grow?	Does it have babies or make others like itself?	Does it die?
Scissors	No	No	No
Chicken	Yes	Yes	Yes
Trillium	Yes	Yes	Yes
Squirrel	Yes	Yes	Yes
Wheelbarrow	No	No	No
Corn	Yes	Yes	Yes
Horse	Yes	Yes	Yes
Pan	No	No	No
Dandelion	Yes	Yes	Yes
Gasoline Pump	No	No	No
Dog	Yes	Yes	Yes
Peach Tree	Yes	Yes	Yes
Bird	Yes	Yes	Yes
Tulip	Yes	Yes	Yes
Rubber Tire	No	No	No

The completeness of the chart will be determined by the pupils' background. It may be that the only characteristic common to both plants and animals upon which all children agree will be that of growth, and that is satisfactory at this level. This lesson may be extended by adding the names of other living and non-living things familiar to the pupils.

Extending and Enriching Activities:

1. The chart suggested above may be modified and extended to combine pictures and text. Oak tag may be used. Cut out pictures of animals and plants very common to the locale, such as squirrels and corn, and mount them under the applicable headings. Later, when the children have made the necessary generalizations, animals and plants with which the children have not had direct experience may be added.
2. The furnishings of the classroom may be classified in terms of living and non-living things. Games using the labels *Not Alive, Alive, Animals,* and *Plants* may be played. The pupils should be sure to label plants not only with *Plants* but also with *Alive,* and animals in the room should also receive two labels. Activities such as these help the children perceive that plants and animals are the two major divisions of living things.

Page 64

Relation to the Unit: To extend the concept presented in *Look and Learn* that flower forms have distinguishing features by which we can tell one plant from another.

Concepts:

A. The general shape of the flower may differ.
B. The number of petals may differ.
C. The arrangement of the petals may differ.
D. The shape of the petals may differ.

Information for the Teacher: The flowers shown in the four rows are petunias, narcissus; pansies, rose; cosmos, columbine; nasturtiums, coreopsis. Flowers familiar to the children should be named. Otherwise, it is sufficient for the pupils to designate those that are most alike. During the discussion develop such words as *shape* and *petal.*

Procedure: "Look at the first row of flowers. All of them are different in color; yet three of them have the same name and are like one another in many ways. Let us find the three that are alike. Do you know their name?" Pupils may wonder why the third flower is also a petunia, since it differs somewhat from the first two flowers. In order to elicit that there may be many varieties of petunias, just as there are many kinds of roses, tulips, etc. ask, "Are the petals on all roses or tulips just alike? Do you know the name of the flower in this row that is not a petunia? How is the narcissus different from the petunias? In what ways besides color are the three petunias different?" Lead the pupils to see that they differ in size, and shape of petals and in markings.

Continue with the other rows, having the pupils note that, while three of the flowers in each row may differ in color, marking, and details of shape, they are more like one another than like the odd one.

Extending and Enriching Activities:

1. The pupils should be encouraged to bring in flowers and compare them, noting relative sizes, number of petals, petal arrangement, texture, odor, etc. These flowers may be pressed and later mounted on dark craft paper and labelled.
2. Encourage pupils to bring in catalogues and make charts of common flowers.

3. Make a flower calendar and mount pictures of plants as they are observed in bloom.
4. If it is at all possible, school gardens should be arranged for; and it is usually satisfactory to devote half the plot to flowers. These, of course, should be rapidly growing annuals so that the pupils can actually see their flowers in bloom before school closes for the summer. Local florists will advise the class about plants best suited to the climate, locality, etc.
5. List the flowering plants that grow on the school grounds.

Page 65

Relation to the Unit: To develop the concept that the leaf structures of plants have distinguishing features by which we can tell one plant from another.

Concepts:

A. The general shape of the leaf may differ.
B. The type of edges may differ.
C. The arrangement and type of veins may differ.

Information for the Teacher: Leaves such as those of the poplar, which are "one piece," are called *simple;* those of the horse chestnut, which are made up of leaflets, *compound;* those of the sugar maple, which have divided edges, are called *lobed;* those of the elm, which have toothed margins, *serrated;* and those of the lilac, which have smooth margins, *entire*. The above italicized terms are not taught, however, at this level.

The teacher must be careful not to generalize that all trees with needle-shaped leaves are evergreens. Neither should she state that all evergreens have needle-shaped leaves nor that all broad-leaved trees lose their leaves in winter.

The leaves used on this page have been selected so that several will be common to most localities. These leaves should be identified and named. They are sugar maple, elm, horse chestnut, sugar maple; white ash, peach, white ash, white oak; poplar, goldskin willow, poplar, box elder; white pine, spruce, white pine, hemlock.

During the discussion develop such words as *edge, leaflet, vein, stem, needle, twig,* etc.

Procedure: Before making a detailed study of the page, ask the pupils whether they have seen any leaves like these, and whether they know the names of the trees from which the leaves came.

Then say, "Look at the first leaf in the first row. There is another leaf in this row that came from the same tree and is the same shape. Find it. Is it exactly like the first leaf? How did you know it came from the same tree? Now look at the second leaf in the first row. How are the edges of this second leaf different from those of the first leaf? Look at the third leaf in this row. It looks as though it were many leaves, but really it is just one leaf. How many parts are there to this leaf? These parts are called leaflets because they look like little leaves."

Tell the pupils that the lines in the leaf are the veins that carry water and food to it. "How are the veins in the second leaf different from those in the first leaf?" Have the pupils trace the main veins and side veins with their forefingers.

Now direct the children to look at the first leaf in the second row. Tell them that it has many leaflets, just like the third leaf in the row above, but that it, too, is only one leaf. Be sure that the children understand this point. "Find another leaf in this row that is like the first one. How are the edges of these leaves different from the edges of the leaves in the row above? Look at the last leaf in the second row. Is there a leaf in the first row that has edges something like those of this leaf? How are the second leaves in each of these rows alike? How are they different?" While pupils at this level cannot be expected to understand such terms as *serrated, lobed,* etc., most children will use highly descriptive language in distinguishing different types of edges. Such terms as *cut out with a saw, saw marks, nibbled, little teeth marks,* etc., are acceptable for *serrated; big bites, torn out as we tear paper pictures, cut out with big scissors,* etc., are acceptable for *lobed.*

Continue with the third row, having the pupils find the two leaves that are alike and tell in what ways they are alike and in what ways they are different from the other leaves in the row.

Have the children reëxamine the first three rows and find (1) the leaves that have leaflets,

(2) the leaves that have smooth edges, (3) the leaves that have little teeth marks or saw marks in the edges, (4) the leaves that have big bites out of the edges, and (5) leaves and leaflets with one heavy vein.

Before proceeding to the last row, help the children generalize that they can distinguish many leaves by asking, "What three things can we look for to help us tell one leaf from another?

"Now look at the last row. We call these *needles*, but they are leaves, too." Continue with this row, helping the pupils see that some needles, such as the white pine, grow in groups, or bunches; some, such as the spruce, grow all around the twig; and others, such as the hemlock, grow on two sides of the twig. The children should also note that some needles are long and slender, while others are short and blunt.

Then ask, "How are the leaves in this row different from the leaves in the row above?" Responses should include the facts that these leaves (needles) are thicker and narrower, that the veins cannot be seen, and that many of these leaves remain on the trees all winter.

Extending and Enriching Activities:

1. Make leaf collections from trees native to the locality. These can be pressed and mounted on sheets of paper, used in leaf books, etc. The leaves should be labeled.
2. The children can be encouraged to observe trees rather than individual leaves by making tree pages. Such pages include a drawing of the tree to indicate its general shape; simple descriptive text about height, thickness of trunk, type of bark, etc.; and a mounted leaf.
3. To focus attention on leaf shapes, it is often helpful to make leaf plaques. (See Appendix, page 159.)
4. Investigate and discuss the uses of trees. Children who live near rivers that sometimes flood can be led to see that plantings of trees with spreading roots, such as the goldskin willow, help hold the soil against the action of the water. Similar uses specific to the locality should be stressed.

Pages 66-67

Relation to the Unit: To extend the idea that plants have characteristic distinguishing features; to give practice in comparing and contrasting.

Information for the Teacher: The plants shown on page 66 are red clover, white clover, alfalfa; tulip, iris, mullein; violet, trillium, viola; carnation, lily, swampcandle. The plants on page 67 are mountain laurel, currant, holly; trumpet-creeper, cranberry, Virginia creeper; magnolia, dogwood, tulip tree; dahlia, azalea, hollyhock.

When the name of a plant is familiar, it should be used, but it is not the purpose of the page to teach plant identification.

Procedure: Have the children turn to pages 66 and 67 and then say, "When we look at flowering plants, we are often so used to telling them apart by the flowers that we forget to look at the rest of the plant. Glance quickly at the first plant in the first row. Now look away from it. Who can tell me what the name of the plant is?" Be sure that the children reply that it is red clover, as there are many varieties of clover. "What color were the flowers? Can you describe the flower?

"How much can you tell about the leaves, without looking at the picture again? You see, we didn't pay much attention to the leaves, although the leaves of the red clover are quite different from those of other plants. Look at the first row of pictures. There is another red clover plant in the row. It has no flowers. Can you find it? How did you know that the last plant in the row is also a red clover? How are its leaves like those on the flowering red clover plant?

"Now look at the other two plants in the row. In some ways the leaves are much like those of the red clover. How are they like the red clover? How are they different?"

Proceed in the same way with the remaining rows. Stress the fact that flower forms are not the sole way of distinguishing one plant from another. In the leaf comparison focus the pupils' attention on general shape, width, length, shade of green, etc., and on such characteristics as were presented in connection with the tree-leaf study on page 65: leaf edges, type of leaf, vein arrangement, etc.

Extending and Enriching Activities:

1. Play games that involve matching activities similar to those on pages 66-67.

2. If the season permits, bring leaf specimens of common flowering plants into the classroom to analyze and compare them.
3. Extend the work of plant comparison to root structure. If possible, use some actual specimens, although pictures can be used to good advantage. Fleshy taproots, long taproots, spreading roots, etc., may be presented.

Pages 68-69

Relation to the Unit: To extend the concept presented in *Look and Learn* that plants follow a definite pattern of growth; to introduce in story form the idea that plants must have light, water, and heat in order to grow.

Concepts:

A. Most plants grow from seed.
B. When these plants mature, they bear flowers.
C. The flowers of these plants produce seeds.
D. The seeds produce the same kind of plant as the parent plant.
E. Some plants live only a year.
F. Plants require various amounts of time for each period of growth.

Information for the Teacher: Before this lesson is presented, soak large seeds, such as Lima beans or marrowfat peas, overnight. (See Appendix, page 158.) Show the pupils the seed structure, pointing out the minute plant and the food stored for its use. (See Appendix, page 158.) Also soak morning-glory seeds. It is advisable to notch these or to soak them for a longer interval. Demonstrate that the roots of plants always grow downward. (See Appendix, page 158.)

Replies to questions should not be forced, as many of the concepts introduced will be further developed in later pages.

During the discussion develop such words as *seed, sprout, root, vine, stem, bud, seed pod*, etc.

Procedure: Have the pupils turn to the unit title page (page 61); then ask such questions as: "Did you ever plant morning-glories? What do morning-glory seeds look like? How long do morning-glory plants live?" Then say, "Today we are going to find out the answers to these questions."

Direct the pupils to look at the first picture in the sequence. Say, "The little girl is planting morning-glory seeds like the ones in the circle. In what season do we plant morning-glories? What kind of weather do we usually have then? Where do you think she got the seeds? She planted the seeds where the ground would get plenty of sunshine. Can you tell the reason why she did this? What else must she do to get the plants started besides put them in the soil?"

At this point allow the children to examine the presoaked seeds. Elicit that water helps soften the hard seed coat so that it will split open easily. Show the pupils that water softens the morning-glory seeds in the same way. Have the children examine the close-up in the first picture and compare the seeds shown there with those that have been soaked in water.

"What has happened to the seeds in the second picture? What parts of the plant do you see above the ground? If the little girl were to dig up one of the plants, what part of it would she find growing in the soil?" Tell the children that one or more weeks are required for the seeds to sprout, or come up.

"What is the little girl doing in the third picture? Why?" Elicit that the morning-glories are vines and would become tangled if they had nothing on which to climb. "How do morning-glories climb?" Have the pupils refer to page 61 to see that the stems of the morning-glories twine.

"How are the plants in the fourth picture different from those in the third picture?

"Look at the fifth picture. What new parts of the plant do you see now? Does anyone know in which months morning-glories bloom?" (From June to September.) "Turn back to page 61 and look at the lower part of the picture. What do the buds of the morning-glory look like? What time of day do the flowers open?" Develop the idea that several weeks of growth are required after the first leaves appear before the plants bloom.

"In the sixth picture what has happened to the flowers? (petals fallen, seed pods formed) How have the leaves changed? What do you think has made them change color? (frost) What season of the year do you think it is? What new part of the plant do you see under the magnifying glass? Where did the seed pods and seeds come from? (flowers) What color

are the pods? When seed pods are brown and dry, we say that they are ripe. What is falling from one of the ripe pods? What kind of plant do you think that seed will make?

"Are the plants in the seventh picture alive?" Bring out the fact that not even the roots are alive and that the snow and high winds have torn down most of the dead leaves and stems.

"What season do you think it is in the last picture? Do you think the little girl planted these morning-glories? Why not?" (Uneven rows and scattered plants indicate that these plants grew from the seeds dropped the preceding autumn.) "Do you think that all the seeds that fell in autumn grew to be new morning-glory plants? Why not?" Responses should include the ideas that conditions were not so good as when the soil was prepared, the seeds were covered, and they received water when needed.

Extending and Enriching Activities:

1. Raise morning-glories in the school window box so that the pupils will be able to watch their development. Much better results will be gained if a small notch is filed in each seed before planting.
2. Using seeds, young seedlings, pictures from garden catalogues, etc., as models, make picture charts of life cycles of other flowering plants.
3. Plant various seeds in flats or pots and note the different time intervals from planting to the appearance of the first two leaves and to the appearance of true leaves. The children should understand from this work that various amounts of time are required for germination and growth from stage to stage. (See Appendix, page 158.)
4. If the season will permit outdoor use later, transplant seedlings (usually when four true leaves appear) to stand three inches apart. Show the children the root structures.
5. Remove a mature plant from the soil to observe the root structure. (This can usually be done without damage to the plant if it is promptly replanted and watered.)

Page 70

Relation to the Unit: To determine the pupils' understanding of the fundamental concepts of plant growth; to promote ability to observe accurately and to perceive the sequent nature of growth and reproduction.

Procedure: "These six pictures tell the story of another plant that grew up. Do you know the plant's name?" Tell the children that the pictures are not arranged in the right order, but that the series begins with the picture in the upper left-hand corner and ends with the one in the lower right-hand corner. Have them indicate the correct sequence of the pictures and cite evidence for it. If any pupil has difficulty in determining the sequence, refer him to the life cycle of the morning-glory on pages 68-69.

If desired, point out that in the case of the morning-glory the seeds merely fell from the ripe seed pod, whereas in the sweet pea they "pop out."

Values of the page may be extended by asking, "Do any of you have sweet peas growing in your own gardens? Did they grow better in a sunny or a shady spot? How high did the plants grow? Did they need something to climb on? What are plants like the morning-glory and the sweet pea called? Were all the blossoms the same color? Why do you think so many people raise sweet peas in their gardens?" Attention may be called to the tendrils shown in pictures 2, 5, and 6 and their relation to the climbing habit discussed. Explain that morning-glories (see page 61) lack tendrils but climb by the turning of the stems themselves.

Extending and Enriching Activities:

1. Continue the work in life cycles of plants begun in connection with the previous lesson.
2. If the children were interested in the function of tendrils, continue the discussion of various vines and their methods of climbing.

Page 71

Relation to the Unit: To compare and contrast seeds of plants; to extend and summarize methods of distinguishing between plants.

Concepts:

A. Plants may differ in the color and shape of their seeds.
B. They may differ in the kind of seed container produced.

Information for the Teacher: The plants shown on this page are morning-glory, nasturtium, petunia; dandelion, milkweed, thistle; apple, peach, cherry.

Procedure: Follow the plan suggested for pages 66-67, and elicit the likenesses and differences in the flowers and leaves of the first three plants on page 71. Then ask, "Can you see in the picture still another part that helps us know what kind of plant each one is?" When the pupils give the response *seeds*, ask them to tell in what ways the seeds of the three plants are alike and in what ways they are different. Bring out the idea that the seeds are alike in that they grow where the flowers were and contain a tiny plant which will produce the same kind of plant as the parent, and that they are different in that the seed containers of each vary in size, shape, and color.

Continue with the next two rows in the same manner, bringing out the likenesses and differences in the flowers, leaves, and seeds.

Extending and Enriching Activities:

1. Make collections of available local seeds. If the season does not permit, inexpensive seed packets can usually be purchased. Individual seeds can be placed in small cellophane envelopes, and these mounted and labelled.
2. Make posters of local flowers. Each poster should consist of drawn or cut-out pictures of a flower and its leaves, buds, seed pods, etc. Put the corresponding seeds in a cellophane or glassine envelope and paste the envelope on the poster.

Page 72

Relation to the Unit: To present various natural means of seed dispersal; to develop ability to compare and contrast.

Concepts:

A. Some seeds have stiff sails and ride in the wind.
B. Some are heavy and merely fall to the ground.
C. Some have hooks or barbs that fasten on moving objects.
D. Some have fluff attached and float in the air.
E. Some are contained in edible fruits and are distributed when man and animals eat the fruit.

Information for the Teacher: The seeds shown on this page are maple, elm, oak, box elder; Spanish needle, poppy, sticktight, cocklebur; willow, cottonwood, violet, cattail; milkweed, plum, pear, orange.

Procedure: Have the children turn back to pages 68-69. Say, "What is the girl doing in the first picture? Yes, she is planting morning-glory seeds. Now look at the last picture on page 69. Did she plant those seeds? Did anybody? How did they get in the soil? When we plan a garden, how do we plant the seeds?" Responses should include the ideas that we plant seeds in such a way as to get the kinds of plants we want in the spots we have selected for them; and that, if allowed to go to seed, plants seed themselves.

Say, "There are many ways in which seeds are planted. Do you remember a seed that pops out of its pod and falls to the ground?" Call the pupils' attention to the sweet pea on page 70. "Do you know any other seeds that fall out or are popped out of their seed pods and fall to the ground?

"Do you think the wind could have anything to do with scattering seeds?" Call attention to the glider and the kite on page 57, and discuss the way they ride on the wind. Add that perhaps some seeds can ride on the wind, too.

Have the children turn to page 72. Say, "In the first row there are three kinds of seeds that ride on the wind as a kite or glider does. Can you find them?" Have the children justify their selection and elicit that these seeds have wings that ride the wind. If possible, bring a winged seed into the classroom and demonstrate the function of the stiff wing. If specimens cannot be obtained, tell the children about the wing construction. Say, "Which seed in the first row is not a glider? What is its name? Why are you sure that an acorn is not a glider as the other three are? What happens to the acorn when it is ripe?" Elicit that it, like the morning-glory, falls. "Sometimes acorns are planted a long way from the oak tree after they fall. What animal plants them?" Elicit that squirrels bury acorns for their winter food and often do not find them again.

"In the second row there are three other kinds of seeds that, like the acorn, are often carried long distances. They are accidentally given rides by people and animals, but the people and animals do not want to eat them. The first plant in the row shows seeds that steal rides. How do you think they steal rides?" Pupils should note that the Spanish needle has sharp hooks and barbs that can hook into clothing or fur of animals. "Let us find two other kinds of seeds in this row that steal rides." Have the pupils justify their choices.

"Look at the third row. Let us find three kinds of seeds that look like one another. How are they alike? Do you think that these small seeds that are attached to bits of fluff are very heavy? Could they float in the air? How do you think seeds like these might be scattered?" If the children hesitate, demonstrate with a feather or a small piece of cotton. "Look at page 71 and see if you can find other seeds that float through the air on fluff. Yes, the dandelion, milkweed, and thistle seeds also have fluff. Now turn again to page 72. How do you think the other seed in the third row is planted?" Tell the children that the seed case of the violet, when mature, snaps open and the seeds, like those of the sweet pea, are popped out into the air.

Call attention to the last row and say, "Three of the seeds in this row pay for their rides by being inside something that is good to eat. Which ones are they? How does the other seed travel? What other kinds of seeds do you know that pay for their rides?" Explain that, when fruits are eaten, the seeds are often discarded a considerable distance from the parent tree and may, under favorable circumstances, germinate and produce new plants.

It should be made clear to the children that although all seeds do not germinate, more hand-planted seeds will germinate and mature than naturally scattered seeds, since hand-planted seeds are assured of relatively fertile soil, moisture, and cultivation.

Summarize the page by asking such questions as "Which seeds could be called gliders? Why? Which seeds could be called floaters because they ride on the wind in another way? Which seeds could be called hitchhikers because they steal rides? Which seeds pay for their rides? Do seeds have to be planted by people in order to grow? What did we find out about ways in which seeds may be scattered?"

Extending and Enriching Activities:

1. Encourage the children to start collecting seeds of all kinds. When the collection is completed, have the children divide the seeds into the following groups: (a) those that glide through the air, (b) those that catch rides on people or animals, (c) those that float on the wind, and (d) those that pay for their rides by being in something good to eat. Put the seeds in cellophane or glassine envelopes. Make a bulletin-board display by pasting the envelopes on large sheets of tag board appropriately headed.
2. Many plants living in or near water produce seeds adapted to water dispersal. These may be presented and discussed, but they will probably be of interest only to children familiar with water plants.
3. Make up stories about the trips of various seeds. Such stories might trace the life cycle of the plant, tell how the seeds were scattered, and which ones germinated and grew into mature plants.
4. Problems such as the following may be posed to illustrate the high mortality of naturally scattered seeds:

   Four seeds blew away from a maple tree at the same time. They rode in the wind; and, when the wind stopped, one glided down onto a highway. The second fell into a vegetable garden. The third glided down on top of an automobile, and the fourth landed in a crack in the sidewalk. Which seed do you think is most likely to sprout? Which one is least likely to sprout and grow?

Page 73

Relation to the Unit: To demonstrate that water is necessary for plant growth; to present further work in the technique of experimentation.

Concepts:

A. Seeds need moisture in order to germinate and grow.
B. Plants die without moisture.

Information for the Teacher: Careful attention should be given not only to the science

concepts but also to the technique of experimentation.

Before the page is begun, be sure that the materials shown will be available. It is usually wise to have several similar experiments done by different groups. Sunflower seeds are used in the pictured experiment because they germinate within two or three days. Any large seed that the teacher knows will sprout quickly could be used instead.

During the discussion, develop such words as *experiment, sprout, roots, stem, first leaves,* etc.

Procedure: Tell the pupils that the girl in the picture wanted to find the answer to the question at the top of the page. Read the title "Do Plants and Seeds Need Water?" and say, "The pictures tell us about the experiment she did in order to find out whether sunflower seeds need water to sprout and grow.

"What is the first thing she did?" (She put a long ribbon of cotton around the edge and down to the bottom of each glass, after having thoroughly moistened the cotton for two of the glasses.) "Then what did she do?" (She put four sunflower seeds on top of the cotton around the edge of each glass.) "What was the next thing she did?" (She poured water into the two glasses having the moistened cotton.) "Do you think that the cotton on the rims of these two glasses will stay wet?" If the children hesitate at all in answering, demonstrate how the water is soaked up into the cotton by putting one end of a ribbon of cotton into a glass of water and letting the other end hang outside. Have the children see that after a few moments the moisture reaches to the very end of the cotton ribbon outside the glass. "Would the seeds that the girl put on the cotton on these glasses get wet, too? Why?

"Now look at picture 2. What has happened to each set of seeds? Which ones sprouted and grew?" Have the pupils observe the leaves, stems, and roots. Explain that many small, fine roots grow from the main root, and that the main root, instead of growing down into the water, may be held in the cotton by these small roots. "What did the seeds have that helped them grow? Did all the seeds on the glasses containing water grow?" The pupils should note that all seeds do not germinate.

"Then the girl wanted to find out if the plants would keep on growing if she took the water away. What is she doing in picture 3? After a few days the plants looked the way you see them in the last picture. What has happened to those in the glass with water? What has happened to the others? What does this show? Why do you think she left the water in one glass?"

Summary: "Through her experiment what did the girl learn that seeds must have in order to sprout? Which picture shows you this? What did she learn that plants must have to keep them growing? Which picture shows you this?" Elicit that the girl really knows the answer to her questions because she has tried to grow the plants in two ways—with water and without water—and has seen what happened.

"Do you think these plants, if they were kept in just a glass of water, would continue to grow and become large plants?" Elicit the pupils' opinions on this, but do not settle the question, since they will be able to answer it themselves by carrying out the experiment suggested below.

"Perhaps you would like to do this experiment here in the schoolroom. What things shall we need?" Help the children assemble materials. With the first picture as a guide, set up experiments and put the glasses where they will not be disturbed. Replenish the water as needed. The children may be interested in keeping a record of such items as:

Number of seeds used for the experiment
Number of days required for seeds to sprout
Number of seeds that sprouted
Part that grew first
Number of days required for first leaves to appear
Number of days required for plant to wilt and die after water was removed
Number of days plants lived in water

When the experiment has been completed, review the problem, the materials, the procedure, the results, and the conclusion.

Page 74

Relation to the Unit: To demonstrate that light is necessary for plant growth.

Concepts:

A. Most plants stop growing after a time unless light is present.

B. These plants do not stay green unless light is present.
C. Plants that have been excluded from the light and have turned yellow will turn green again when they are exposed to the light, provided they are still alive.
D. These plants eventually die if deprived of light for too long a time.

Information for the Teacher: The value of the lesson will be greatly increased if the pupils duplicate the experiment. However, the experiment must be carried on over a fairly long time interval (with some plants as long as a month); and so, if preferred, deductions can be made from the pictures alone. If at all possible, the experiment should be duplicated; and it is suggested that healthy young plants, such as petunias, pansies, etc., be used. The local florist or nurseryman will usually be glad to furnish stock that is near the budding stage.

Procedure: Before distributing the books say, "If you wanted to make sure that plants needed light in order to grow, what would you do?" If the children haven't any ideas, recall the experiment showing that plants need water. "Yes, perhaps we could plan an experiment that would show us whether plants need light to grow."

Distribute the books and have the pupils turn to page 74. Ask them if they know what kind of plant is growing in the two pots. If they do not know, tell them that the plants are narcissi, or paper-whites, according to the more common local name. Read the title and elicit that this is the question the boy is going to answer experimentally. Call the pupils' attention to the fact that the boy has two plants. Then ask, "What is he going to do with one of them? What will covering it with a box do? Yes, the plant will get no light. What will happen to the plant that is covered with the box if it is true that plants need light in order to grow?"

After directing the children's attention to the second picture, ask, "Is the plant dead yet? Do you think the boy took the box off the very next day? How do you know he didn't?" Pupils should note that the plants have grown enough to indicate that there is a fairly large time interval between pictures 1 and 2. "How are the plants different now?"

Have the children look at the third picture. Ask, "What has happened to the covered plant now? What has happened to the other one?

"The covered plant in the fourth picture is not dead, but what has happened to it? What has happened to the other one? What color do plants become when they have been kept from the light? What do you think will happen if this yellow, wilted plant is left out in the light?" (Since it is not dead, it will revive and turn green.)

Summarize the discussion by asking, "Did the boy find out whether plants need light? What happened to the plant that had no light?" Be sure the pupils understand that the plant without light turned yellow and did not reach maturity and would eventually die if deprived of light for too long a time.

If it is at all possible to duplicate the experiment, say, "Suppose we do this experiment, too. What do we need? What shall we do? Shall we water our plants?" Explain that the experiment is based solely upon the exclusion of light, and so the plants should receive other normal care.

Set up the experiment, using several pairs of plants for various groups. Exclude light in various ways: by covering with boxes, putting in a dark closet, etc. The children should note:

The relative size of the plants at the beginning of the experiment
The number of days that pass before the covered plant begins to lose color
The number of days that pass before the uncovered plant develops buds and whether or not the covered plant develops buds
The height to which the plants grow
The number of days that pass before the covered plant begins to lie back
Whether the covered plant eventually dies

Extending and Enriching Activities:

1. Have the children tell about or find examples of plants that have turned yellow because of insufficient light. These might include house plants left in a north window in winter, onion sprouts left in the basement, etc.
2. If the season permits, cover a growing plant in the garden. A flowerpot, a cone of paper, etc., may be used. Note what happens.
3. Cover grass with a plank or leave a basket on the grass. Note how long it takes for the

grass to start turning yellow. Remove the plank or basket and see what happens.

4. Play games and pose problems that stress the need of plants for light.

Page 75

Relation to the Unit: To check pupils' understanding of the concepts developed on pages 73 and 74; to promote ability to infer cause-effect relationships.

Procedure: "Look at the first picture in the top row. What is the name of the young plants that are being set out?" (Tomato.) "Why are they drooping?" (They have been out of the earth and have had no water for a time.) "Now look at the next picture. What is happening? What do you think will happen to the plants?" (They will stand up straight and grow again.)

"Describe the grass you see in the first picture of the second row. What is the little girl doing in the second picture? Why do you think she is putting tar paper over one part of the grass? What will happen to the grass under the paper if the paper is left there long enough? Yes, it will become yellow and limp. Why? If the paper is left for a still longer time, what will happen? Yes, the grass will die. Why?

"What is lying on the grass in the first picture in the last row? When the little girl lifts the board, what does she find has happened to the grass underneath it? Why? If the board is left there too long, what will happen to the grass?

"The grass under the board is not dead. If the girl takes the board off the grass, what do you think will happen?: (The grass will become green and soon will be healthy-looking and strong again.)

Extending and Enriching Activities:

1. Transplant two groups of seedlings (any variety will do, provided they have reached the four-leaf stage) to two flats of dry soil. Water one flat. Do not water the other. Observe the results.
2. Duplicate the activities shown in rows 2 and 3. Use tar paper, or roofing paper, asphalt shingling, etc. Cover grass with paper until grass turns yellow (this usually requires several days). Remove one piece of tar paper and observe the changes that take place. Leave the other piece of paper on the grass until the grass is dead.
3. Summarize what has been learned regarding plant growth. Indicate which facts were determined experimentally and discuss the value of experimentation.

Pages 76-77

Relation to the Unit: To show how animals and man aid in the distribution of seeds.

Procedure: Tell the children that the eight pictures present a story. Then guide them through the picture sequence by asking, "What is the name of the plant shown in the first picture?" If no one knows, tell the children that it is a burdock. Then say, "What are the brown things on the plant? What do you see all over the outside of these seeds or burs? Have we seen burs like this on another page in our book?" Page 72 gives a detailed picture of the cocklebur. "What did we find out about cocklebur when we studied page 72?

"What has happened in the second picture? What is the puppy trying to do? Why can't he get the bur out? Where do you think he is going in the third picture? How does he show the little boy what is wrong? Why can't the boy get the bur out alone? What does the father do in the sixth picture? Why does he give the bur to the boy? What does the boy do with it?" Throughout the questions bring out the fact that, because of the stickers on the bur, the plant becomes propagated in entirely different surroundings. Stress the fact that there is high mortality in naturally-sown seeds—the wind carries them to gutters and drains, to paved streets where they are crushed, etc.

Extending and Enriching Activities:

1. Have the children bring in various kinds of seeds adapted by nature for hooking rides, like the cocklebur in the lesson. Allow the pupils to take the seeds in their hands and feel the rough barbs on the seed coats. This will help them understand why seeds of this type adhere easily to everything passing by.
2. Make a bulletin-board display by mounting a piece of soft flannel or wool material on a sheet of tag board and placing the seeds on the cloth. Let the children see how difficult it is to detach the seeds.

GUIDEBOOK for How Do We Know?

UNIT 1: Animals

General Concepts

A. Animals are classified into groups on the basis of their general physical characteristics.
B. Species of animals within a group have distinguishing characteristics.
C. Animals have structures that enable them to get food in various types of habitats.
D. Animals have food-getting structures that are classified as primary or secondary according to use.
E. Food-getting structures are related to the types of foods eaten.
F. Animal population is related to the available food supply.
G. Wild-animal life can be conserved by man.

(For a more detailed outline, see the Index to Concepts, pages 94-95 of *How Do We Know?*)

Introducing the Book

Before the books are given to the pupils, suggest that they tell about the animals they have for pets. As the discussion goes forward, ask: "What do your pets eat? How do they eat it? Do all your pets eat the same kinds of foods? How would pets get food if they had no one to feed them?" (They would have to hunt for food.) "What would the different pets find to eat?" To stress the fact that animals which eat other animals must be specially fitted to hunt and secure prey, ask: "Are cats good hunters? Why?"

In answer to the last two questions the following observations about cats should be contributed by the pupils:

1. Cats walk without noise.
2. Cats move quickly.
3. Cats can climb.
4. Cats have long, sharp claws.
5. Cats have good eyes.
6. Cats have long, sharp front teeth in both upper and lower jaws.

From their own experiences the pupils should explain how each of the above attributes helps a cat get mice, rats, birds, etc.

Use a familiar wild animal, such as the squirrel, to extend the presentation of animal food habits. Then holding up a copy of *How Do We Know?* say: "Here is our new book. In it there is information about many kinds of animals. It tells what they eat and how they get food. What does the picture on the cover show? What is the title of this book?"

Discuss the meaning of the title and lead the pupils to suggest that the things we know are learned (1) by actual experience, (2) by hearing about them from others, and (3) by learning about them from pictures and reading matter in books.

Pass individual copies of *How Do We Know?* to the group. Allow time for the pupils to examine and comment on the cover picture and then have them turn to the title page. They should note that the butterflies on the blossoms of the butterfly weed are of three different kinds. After this observation ask: "Which of these kinds of butterflies have you seen? Why are they on the flowers?"

NOTE: At this time the teacher should consult the Appendix of this *Guidebook* for suggestions on providing first-hand experiences with plants and animals. The collection of insects and small mammals should be started now, so that facts gained from the study of the book may be implemented by knowledge gained from observation of the habits of animals over a long period.

Page 3

Relation to the Unit: To introduce the unit's centre of interest; to provide the teacher with an opportunity to explore the children's background of experience.

Information for the Teacher: The animals pictured are chipmunks, belted kingfisher (with minnow in his bill), great blue heron, screech owl, gray squirrel, cedar waxwings, great crested flycatcher (pursuing the insect), mallard ducks, frog, deer mouse, raccoon (eating the crayfish).

The relative sizes of the animals shown can be judged by the size of the great blue heron, which is about four feet long, or by the life size of the more familiar chipmunk, which has a body length of ten inches including the tail.

Although these particular animals do not represent a natural group in any small area, they are deliberately pictured together to serve as a basis for discussion that will reveal the extent of the pupils' readiness for the work of this unit.

Procedure: Have the children turn to page 3, and say: "This page tells us what the first part of our book is about. What do you see on this page?" The teacher should notice how many of the animals are correctly identified and should give help in identifying any animal that is unfamiliar. Then ask, "What is one name we can call all the creatures pictured on this page? (animals) What is the word at the bottom of the page?"

Encourage discussion drawn from the children's actual experience by asking: "Have you ever seen any of these animals? Tell us about them."

The pupils may classify the animals on this page into three groups in order to review the common characteristics of birds, mammals, and insects, as presented in the *Guidebook* section for *All Around Us,* page 50.

1. Birds are covered with feathers.
2. Birds have two legs.
3. Birds have two wings.

1. Mammals have hair on their bodies.
2. Mammals are born.
3. Mammal babies get milk from their mother's body.

1. Insects have six legs.
2. Insects have two feelers, or antennae.
3. Insects often have wings.

Guide all discussion of page 3 so that the following concepts are stressed:

1. There are many different kinds of animals.
2. Animals eat different kinds of food.
3. Food-getting is the major activity of animals.
4. Locomotion is closely allied to food-getting.

As an aid in crystallizing these concepts ask questions similar to the following: "In what kind of place are these animals? (wooded place or forest) What are most of these animals doing?" (eating or hunting food) Present the words *forest* and *hunters* as further preparation for interpretation of the first story and the succeeding work of the unit. Then ask, "Can you tell what some of them are eating? Do all of them catch their food in the same way? Are all of them eating other animals? Can you tell what part of its body each animal uses in order to get its food and to eat it?"

Stress the fact that the heron is a wading bird and that its long legs enable it to wade out into fairly deep water to get frogs and fish. Note the bill structure and discuss how this kind of bill helps the heron catch fish in water. Explain that the heron flew up on the high perch *after* it had caught the frog and that the heron can easily spy out food in water from an overhead perch.

In case pupils are unfamiliar with the eating habits of ducks, explain that mallards eat almost anything they can find in water—water plants, small fish, frogs, etc. The webbed feet of the ducks and their manner of diving should be stressed.

Call attention to the fact that the kingfisher has a bill similar in shape to that of the heron and that he also catches fish. Then ask, "Can the kingfisher get his food by wading into the water as the heron does?" The answer should bring out the fact that the only way the kingfisher can get fish is to dive and snatch them with his pointed bill.

Since the terms *land animals* and *water animals* will be used throughout the study of the unit, their meanings should be discussed at this point.

By the use of the following procedure the teacher may secure definite information as to the maturity of individual pupils. Say, "Let's look through our book to see if any of these animals on page 3 are shown again." A description of each animal should precede the search, and the teacher should make careful notations of the completeness of the descriptions given by the pupils: whether descriptions are confined to color and markings, whether they include reference to general shape and structure, and whether they include detailed analysis. It

is also advisable to give close attention to the children as they search through the book for the various animals. The teacher should observe (1) the confidence with which each child undertakes the task, (2) the method he uses (whether he leafs through at random or begins at page 4 and progresses methodically; whether he glances too casually at each page or uses good judgment in his time allotment to a page), (3) the completeness of his search, and (4) the scope and language of his report. All such observations are helpful in evaluating the child's readiness for the concepts of *How Do We Know?*

NOTE: In case there is evidence that some pupils lack the experiences essential for the work of this unit, the teacher should provide the necessary background through animal picture books, moving pictures, and excursions. (See the Appendix for general suggestions on field trips.)

Conclude the discussion of page 3 by saying, "We have learned many things about some of the animals on this page. Next time we are going to read a story about an animal that isn't shown here, but it might be hiding in the forest."

Pages 4-5

Relation to the Unit: To introduce in story form two major concepts of the unit.

Concepts:

A. Animals have structures that enable them to locate and get food.
B. Animals eat different types of food.

Information for the Teacher: The teacher should make it very clear to the children that the cat is a wildcat rather than a domestic cat. The species is the eastern bobcat or bay lynx. Bobcats range from Nova Scotia and southern British Columbia over practically all of the great forest areas of North America. The full-grown animal is about two feet long and weighs about twenty-five pounds. Cats are not noted for a keen sense of smell. Therefore, the teacher should correct any false inferences pupils may make in this respect.

Since verbal text to be read by the pupils is presented in *How Do We Know?* for the first time in this series of science books, great care should be exercised by the teacher in its presentation. (See the Vocabulary, page 2.) A preferable way may be to have the children examine each picture before reading the accompanying text. Thus they may perceive how the verbal text serves (1) to supplement the picture interpretation, (2) to direct detailed examination of the pictures, and (3) to suggest the points to be discussed.

At no time should the teaching of science concepts be delayed merely because of any pupil's difficulty with vocabulary. If a child has trouble with any part of the text, the teacher should supply prompt assistance, in order that the pupil's attention may at all times be focused upon the concepts involved rather than upon a reading lesson. A list of the new words appears on page 156 of this *Guidebook.*

Procedure: When the books have been opened to pages 4 and 5, ask: "What pet does the big animal resemble? Does this cat look to be larger than our pet cats? This kind of cat is known as a wildcat or bobcat." (See Information for the Teacher in this lesson plan.)

Present the title and ask, "For what do you think the wildcat is hunting?" Explain that the eight pictures on these two pages constitute a story and that they, as well as the verbal text under them, are to be read. Indicate the order of progression, from left to right, on page 4 and then on page 5. Direct the pupils to look at the first picture on page 4 and read the text. They should comment on the alertness of the cat and the advantage of the fine observation point it has selected.

Then say: "How did the wildcat get into the tree? Look at the next picture. What is the big cat doing?" After the pupils have read the text, ask, "Do you think the wildcat will capture the grouse?" During the ensuing discussion the pupils should observe that the wildcat, like other members of the cat family, is able to leap and land accurately on its feet.

Have the pupils examine the third picture and read the text. Then say, "Why do you think the grouse was able to get away?" Explain that a bird's hearing is acute, and therefore the grouse was warned by the swish of leaves as the cat leaped through them.

After the pupils have discussed the next picture and have read the text, ask, "Why is it possible for the wildcat to move so softly through the woods?" Pupils who are familiar with domestic cats will mention the heavy

pads on a cat's feet that enable it to walk without noise. They should point out the pads on the wildcat's feet.

Then ask the following questions: "What is the rabbit doing? What is it eating? Do you think the wildcat will be able to catch the rabbit?" Stress the keen hearing of a rabbit and its ability to move rapidly.

Continue in the same manner with the pictures on page 5, using the text and oral questions to supplement the picture interpretation and to guide the discussion. Call particular attention to the close-up of the claws in Picture 7. Compare the paw in this picture with those in Picture 1, page 4, and say: "Can you see the wildcat's claws in Picture 1? Where do you think they are?" These questions should bring out the fact that a cat's claws can be extended and drawn in. The term *retract* may be used. Have the pupils indicate the pictures in which the cat's claws appear to be retracted and those in which the claws are extended. Discuss how its claws enable the cat to hold the rabbit securely in Picture 8.

Lead the pupils to generalize on the basis of facts brought out in the discussion of the pictures by asking, "Why was the wildcat able to catch the rabbit?" The answers to this question should include the following observations concerning the wildcat:

1. It has keen eyesight.
2. It has claws that can be retracted while it is walking or running and extended to assist it in climbing and in holding prey.
3. It has pads on its feet that enable it to walk without noise.
4. It has strong muscles that enable it to leap and to pounce upon its prey.

Then say: "Look back through the story and find the different things the wildcat tried to get for its dinner. What were they? What would be a good name for animals that catch other animals for food? ("meat-eaters" or "animal-eaters") Look at the wildcat's mouth. How do you think its teeth help it eat other animals?

"One other animal in the story was eating food, too. What was it eating? (twigs) What kind of eater might we call the rabbit?" ("plant-eater")

Extending and Enriching Activities:

1. The pupils should begin to collect animal pictures. Since food-getting and the body structures involved in food-getting are of primary importance in this unit, the pictures should stress food habits in so far as possible. Pictures in color are preferable, and they should be individually mounted so that they can be used for various purposes as the study of the unit goes forward.
2. If possible, a gentle pet cat should be brought to school and compared with the pictures of the wildcat. Examine particularly the claw and mouth structures of the cat, taking precautions against being scratched or bitten by wearing heavy gloves while handling the cat.
3. List and discuss other familiar members of the cat family and their food-getting structures and habits. The Bibliography, pages 164-172, indicates the type of reference material that will be helpful to pupils in this and many other activities in connection with the study of *How Do We Know?* (See especially *Homes and Habits of Wild Animals,* by Karl P. Schmidt; *Parade of the Animal Kingdom,* by Robert Hegner; *Wild Animals of North America,* by E. W. Nelson; and *First Book of Cats,* by Gladys Taber.)

Page 6

Relation to the Unit: To extend the major concepts of the unit by presenting in story form a method of food-getting other than pursuit; to review the distinguishing physical characteristics of insects.

Information for the Teacher: The female golden garden spider is more than an inch long. The male is much smaller and is differently colored.

The young of spiders come from eggs laid by the female. Spiders are not insects. They are classed as a separate group of animals, for their bodies have only two parts—the head and thorax being consolidated into one part—and they have eight legs instead of six. A spider usually has eight simple eyes, while an insect has two compound eyes. (The book *Animals Without Backbones,* by Ralph Buchsbaum, contains good enlarged photographs. See the Bibliography, page 165.)

The weaving patterns of webs differ with the different kinds of spiders. The spinning organs of the spider (spinnerets) are in the tip of its abdomen, and the silk is manufactured within the spider's body.

Unreasoning fear of spiders should be dissipated by informing the pupils that spiders use their poison only in self-defense or in subduing insects that constitute their food. The black-widow female spider, whose bite is the most venomous to man, is found in large numbers in the southern United States but very rarely in Canada. It is one-half inch long and is characterized by a red mark, shaped like an hourglass, on the underside of the abdomen.

Procedure: Before the pupils open their books, say: "The next animal shown in our book eats animals that fly. Yet it cannot fly to pursue them. It has to use a trick or a trap to secure food. What is a *trap?*" Bring out the fact that one who sets traps for mice, foxes, etc., is a *trapper.*

Have the pupils read the title on page 6. Then ask, "What is this trapper that lives in a garden?"

Present the word *spider* and explain that this particular spider is known as the golden garden spider. Discuss briefly other kinds of spiders the pupils have seen indoors and out.

Have the children read the text as a guide in the study of each picture. After Pictures 1 and 2 have been interpreted, explain that the spider can readily detect the presence of its prey because it can feel the slightest movement of the web.

When the question under Picture 3 has been answered, tell the pupils that the spider spins threads about her victim after she has paralyzed it by stinging it. Then she sucks the juice from the insect's body and detaches the dead insect from her web.

In order to stress the difference between the food-getting methods of the wildcat, which pursues its prey, and the spider, which uses a web to trap its food, ask, "How is the spider's way of getting food different from that of the wildcat?"

Contrast the external structure of a spider with that of the insects shown on pages 18 and 19 to bring out the fact that spiders cannot be classified as insects. The term *arachnid* may be presented as the scientific name for a spider.

The following facts may be listed by the pupils as the basis for the conclusion that spiders are not insects:

1. Insects have six legs.
2. Most insects fly.
3. Insects have three parts to their bodies.

1. Spiders have eight legs.
2. Spiders crawl.
3. Spiders have two parts to their bodies.

Add other differences which may be discovered from books, pictures, or the observation of live specimens.

Extending and Enriching Activities:

1. Most pupils are fascinated by the web-making process. While it is not always possible to observe a spider during actual web construction, it is often possible to find a web of the golden garden spider and observe its structure. (An excellent account and diagrams of web-making will be found in the *Field Book of Insects,* by Frank E. Lutz, pages 29-30. See the Bibliography, pages 164-172, for other books about spiders.)
2. If the season permits, locate a spider and a web. Have the children touch one portion of the web lightly with a twig to find out whether the spider will come to the vibrating portion. Drop bread crumbs or a leaf on the web to see how the spider will react.
3. Ascertain what other species of spiders can be found in the immediate environment. Use reference books to identify the species.
4. Add pictures of different kinds of spiders and spider webs to the picture collection and study pictures in books such as that listed in Activity 1 above.

Page 7

Relation to the Unit: To extend in story form the major concepts of the unit; to present a plant-eating animal that is equipped with teeth fitted for gnawing.

Information for the Teacher: Beavers are not so numerous in Canada as they once were, but they still occur in most wooded areas of our country.

A full-grown beaver weighs from forty-five to sixty pounds, and its body is about thirty inches long. The tail, which is covered with scales, is about ten inches long and serves as a rudder in swimming.

For protection from such enemies as wolves, foxes, and wildcats, beavers build their homes in water instead of on land.

Beavers eat roots and stems of water plants and bark and twigs of aspen, cottonwood, and willow trees.

Procedure: Before the books are opened, have the pupils recall the type of food (animal or plant food) the wildcat, rabbit, and spider eat and their methods of getting it. The discussion should indicate that pupils know that, unlike the wildcat and the spider, the rabbit neither pursues nor traps its food, since it eats plants. Then say, "The next animal we shall read about eats plants, too, but it has to work harder to get its food than the rabbit does."

After presenting the title, have the pupils read the text and discuss the pictures. Point out that the beavers are eating only the twigs and buds and that in order to get food they have to cut down the tree. The pupils should note the beavers' home in three of the pictures and observe that the heavier branches of the tree are used for home-building. Bring out that beavers can move about both on land and in the water and that their webbed hind feet as well as their long flat tails aid in swimming. Emphasize particularly the fact that beavers have teeth which are fitted for gnawing wood. Compare these gnawing teeth with the teeth of the wildcat on pages 4-5.

Discuss the food preferences of the beaver as compared with those of the wildcat, the rabbit, and the spider. Then ask, "Which of these animals are meat-eaters? Which are plant-eaters?"

Extending and Enriching Activities:

1. Use pictures and books (see the Bibliography, pages 164-172) to find out (a) how beavers build their homes, (b) how they store their food supply for winter, and (c) how they build dams that insure sufficient water about their homes.
2. Discuss the food habits of other familiar mammals that have gnawing teeth, particularly mice, squirrels, and rabbits.

Pages 8-9

Relation to the Unit: To present additional examples of food-getting habits and the structures that equip animals to get food on land; to develop the ability to classify on the basis of observed facts.

Concepts:

A. Some animals can move about and get food on land.

B. Animals may be classified according to the type of food they generally eat.

Information for the Teacher: The animals shown on page 8, from left to right, are cottontail rabbits, mother porcupine with young porcupine; ruby-throated hummingbird, praying mantis, goldfinch; red squirrels, weasel.

The only animal on page 9 that may not be recognized by all pupils is the mother coyote with two of her young in the last picture.

A specialized tongue enables the hummingbird to get the nectar from flowers. The long tongue is cleft, and the inrolling edges of the two portions form a pair of tubes.

The beetle being caught by the mantis is a Japanese beetle.

The buds being eaten by the red squirrel at the left are sassafras, for which red squirrels have a strong preference. In Canada this variety of small, tree-dwelling squirrel is found in almost all the wooded areas, extending almost as far north as the tree line. Its food consists largely of pine and spruce cones and tender buds of deciduous trees, but like other species of squirrels it will eat birds, small mammals, and insects.

The bears are eating wild berries, insects that burrow in bark, and fish. Other kinds of foods eaten by bears will be suggested by pupils who have observed bears or have read stories about them.

Procedure: The pupils should read the title and identify each animal. They should read and consider each question separately and find the pictures which answer it. The questions may be written on the blackboard by the teacher. The right animals should be listed under each question as they are suggested by the pupils.

In order to elicit the generalization that animals may be classified according to food preferences, say, "Sometimes we group animals according to the way they look and how their bodies are formed. We know that insects have

six legs and two feelers, that mammals have hair or fur and drink their mothers' milk when they are young, and that birds are covered with feathers and have two wings. On this page how are we putting animals into groups?" (according to what they eat and where they find their food) Be sure that pupils understand that the diet of meat-eaters (carnivorous animals) is largely meat, though not exclusively; that the diet of plant-eaters (herbivorous animals) is largely plants; that the food preferences of some animals (omnivorous animals) and man are so equally divided between meat and plants that neither the term *meat-eaters* nor *plant-eaters* can be applied exclusively to them. Do not present to the pupils at this time such terms as *carnivorous, herbivorous,* or *omnivorous.*

Direct the pupils to examine each picture on pages 8-9 and then be ready to tell how each animal is fitted to get the food it is eating.

Give guidance, if needed, in the formulation of these statements. The wording may vary from that of the following sentences, but each statement must show understanding of the relation between structure and food-getting.

1. The hummingbird has a long, slender bill that can reach into deep-throated blossoms and get nectar.
2. The mantis has hinged and barbed forelegs that can close on an insect and hold it fast.
3. The weasel has a slender body that can squeeze into the hiding places of small mammals.
4. The horse, cow, and sheep have long necks, and so these animals can eat grass while standing up.
5. The giraffe has a long neck and tongue that enable it to reach up to trees and get the tender leaves it likes.
6. The bear has heavy paws that can stun fish and scoop them out of water. Its long, strong claws can tear bark off logs and claw out insects; and its paws can be used like hands to hold food.

Extending and Enriching Activities:

1. Discover the food preferences of pets and wild animals in the locality. Pictures of such animals may be drawn, painted, or cut from magazines to make posters. Each poster should show an individual animal with pictures of the food it eats.
2. The foods that the pupils eat during a day may be listed and classified as "animal" or "plant" food.
3. The teacher should write in separate columns on the board "meat-eaters," "plant-eaters," "meat-and-plant-eaters." Then have the pupils list the animals on pages 3-9 under the heading that describes the food they are eating in the pictures. Suggest that these lists may need to be revised in the light of later information which the pupils may acquire. Books about birds, mammals, and insects should be examined for other examples of meat-eaters and plant-eaters. (See the Bibliography.)

Page 10

Relation to the Unit: To present examples of animals that can obtain food in water.

Concepts:

A. Fish are equipped to locate, pursue, catch, and eat food in water but not on land.
B. Some mammals and snakes can get food both in water and on land.
C. Fish have common physical characteristics that differ from the common characteristics of birds, mammals, and insects.
D. Snakes have physical characteristics that differ from those of other classes of animals.

Information for the Teacher: The species of snake shown is the common brown water snake. It is the first example of a reptile.

The small fish is a chub, and the larger one is a pike.

The mink's range in Canada is the entire area with the exception of the barren tundra of the Arctic. It is a flesh-eater and attains a length of two feet including the tail, and a weight of about two pounds.

Procedure: Recall that the cat is a "hunter" and say: "We are now going to read a story about other hunters. What is the title of this story?" After the title has been read, direct the pupils to study the pictures and text in order to interpret the sequence of action. During the discussion the pupils should make the following observations: In Picture 1 the

chub is attempting to catch the dragonfly for food and is swimming after it. The pike is pursuing the chub, while the snake is lying in wait for its food. In Picture 2 the dragonfly has escaped by reason of its ability to fly and the chub has been caught by the snake, which lay quietly in a position that enabled it to dive and grab the fish as it went by. In Picture 3 the pike, in full pursuit of the chub, cannot see the mink.

The pupils should perceive that in each case food-getting depended upon the ability to move about. Discuss the types of locomotion shown in the story.

Call attention to the fact that the snake's body is well fitted to obtain its point of vantage in its quest for food. Ask what the pike would have done if it had been aware that the mink was after it.

Point out that while the mink can obtain food in water, it does not eat under water. Explain also that the water snake can catch and eat food both on land and under water. Discuss the differences in external structure of the snake, the mink, and the fish. The teacher may at this time explain that mammals and snakes have lungs as humans do and cannot breathe in water, while fish have gills that fit them for getting air in water.

An aquarium with goldfish or other suitable fish should be in the schoolroom. (See the Appendix, page 154.) Pupils who may be curious as to how fish breathe in water can observe the gills and their constant movement.

Contrast the external structure of the pike with that of the mammals, birds, insects, and spider on previous pages of *How Do We Know?* stressing differences in their structures. Such an activity will lead the pupils to conclude that fish cannot be classified in any of the three main groups—birds, mammals, and insects. Explain that fish are classed as fish. A list of the common characteristics of fish should be made.

1. Fish have fins instead of legs.
2. Most fish are covered with scales.
3. All fish have gills.

Similarly contrast the snake with examples of the known classes of animals and make a list of the common physical characteristics of snakes. For example:

1. Snakes have no legs.
2. Snakes are covered with scales.
3. Snakes have lungs.

Since scales do not show in the picture, the teacher should be sure the pupils know that snakes resemble fish in body covering. Pupils should note that both snakes and fish have no legs and that both have scales, but since snakes have no gills, they cannot be classified as fish. Unless the information is requested, the fact that a snake is a reptile need not be mentioned until after the other examples of reptiles have been presented.

Extending and Enriching Activities:

1. In discussing how fish are fitted to live in water, the fact that they have gills which enable them to breathe under water will be mentioned. However, since most pupils will not know that there is air in water, a simple experiment may be performed to demonstrate this fact. Let a glass of cold water stand for an hour, and notice the bubbles of air that form on the inside of the glass. Explain that as water passes over the gills of fish, the gills extract the air that makes breathing possible.
2. Use reference books on fish and snakes in order to stress the differences and common likenesses among the individuals of each group. (See the Bibliography.)
3. If the aquarium is not completely stocked, ascertain what water animals might be able to live in it and how to feed them. After such animals have been added to the aquarium, pupils should record the information they gain from observing the habits of the animals. (See the Appendix, pages 154-156, and books such as *Science Experiences for Elementary Schools,* by Charles Arey, and *Handbook of Nature Study,* by Anna Botsford Comstock, which are listed in the Bibliography.)

Page 11

Relation to the Unit: To present additional examples of animals that are equipped to obtain food in water; to promote ability to see the relationship between structure and food-getting.

Information for the Teacher: The animals shown from left to right are crayfish (eating

tadpoles), carp; northern sea lions; octopus (with a blue crab), brown pelicans. The animals are not in scale as to their relative sizes, but each one is in scale with the food it is eating. Their life sizes are as follows: crayfish, three to four inches long; carp, about nineteen inches; northern sea lions, as much as twelve feet, the males being twice as big as the females; octopus, ten feet or more in diameter; brown pelicans, four and one-half feet long.

Crayfish—of which there are numerous species—belong to the class known as shellfish, or crustaceans. They are hatched from eggs.

Octopuses are found in nearly all seas. They are mollusks and have gills.

Procedure: Have the pupils read the title and give them any needed help as they identify each animal. Inform them as to the life sizes of the animals that are unfamiliar. The three questions should be discussed in a general way so that the teacher may determine whether the pupils understand what they are to do. Each question should then be answered individually.

In answering the last question stress the food-getting structures of each animal: the divided claws of the crayfish; the two rows of suckers on each of the eight arms, or tentacles, of the octopus; the large bill and scooplike pouch of the pelicans; etc.

Compare and contrast the various ways in which animals get food in water. In connection with the second picture, the pupils should recall that fish also eat other fish. If necessary, have the children look again at page 10.

Compare and contrast the external structures of the crayfish and octopus with mammals, birds, insects, spiders, fish, and snakes, thus leading the pupils to conclude that the crayfish and octopus do not fit into any one of the classes of animals previously studied. There is no need at this time to present the names of the groups to which these two animals belong.

Extending and Enriching Activities:

1. If it is possible, bring a crayfish, which can be found in most rivers, or a lobster specimen (the structures of these two animals are comparable) into the classroom for examination. Examine the claws and the shell structure carefully. After the pupils have become familiar with several varieties of shellfish through real specimens or pictures, they should list the common characteristics for later reference. Conduct research on the food habits of the crayfish and decide whether or not it would be a good animal to add to the aquarium.
2. Collect pictures of marine birds and discuss the ways in which they get their food.
3. Have the pupils turn back to page 3 and discuss the animals that obtain food in water. Compare their methods of getting food, methods of locomotion, food-getting structures, etc.

Page 12

Relation to the Unit: To demonstrate that some animals are equipped to get and eat food both in water and on land.

Information for the Teacher: The turtles shown are the species known as Blanding's turtle. This kind of turtle is common in many areas in southern Canada. It is about seven inches long and five inches wide and is one of the few species of turtles which feed on land but can also swallow under water. Its food consists of earthworms, tadpoles and young frogs, slugs, minnows, and succulent vegetation. Turtles belong to the reptile class.

Procedure: After the pupils have read the title, they should study the pictures in order to interpret the amusing story. The questions on the page should then be answered. A detailed discussion can be motivated by the teacher as follows: "What are the turtles doing in Picture 1? What are they doing in Picture 2?" Explain that the turtles in Picture 3 are the same ones shown in Pictures 1 and 2 but are closer to us and therefore seem larger. "Would you say that these turtles are meat-eaters or plant-eaters or both? How do webbed feet help turtles get food? Do you think their claws are as useful on land as they are in the water?"

Extending and Enriching Activities:

1. Live specimens of turtles common to the locality should be examined. The children should note their likenesses and differences, such as size, shell markings, foot structure, etc. Reference books on turtles (see the Bibliography) should be consulted in order to identify the local species.
2. Through the handling of live specimens the children will be able to ascertain and list the following facts:

a. Turtles have thick, scaly skins.
b. Turtles have shells made up of thick, hardened scales.
c. Turtles have hard, bony plates in their jaws instead of teeth.

The teacher may contribute the following additional information:

a. Turtles hatch from eggs.
b. The temperature of a turtle's body is always the same as the air or water about it. Its blood cannot keep it warm in winter, so it is called a "cold-blooded" animal.
c. Turtles breathe with lungs.
d. They have backbones.

When the pupils have considered all these facts, they should determine whether or not turtles belong to any of the known classes of animals. The fact that turtles are reptiles and the characteristics that determine their classification can be presented later.

Page 13

Relation to the Unit: To review the different types of locomotion; to promote perception of the relationship between the food-getting structures and the habitats of some animals.

Information for the Teacher: Vertically, the animals are as follows: eastern chipmunk, house cat, rooster, mink; viceroy butterfly, woolly bear caterpillar (adult is Isabella tiger moth), Baltimore oriole, short-horned grasshopper, bluegill fish; Canada goose, lamb, little blue heron.

Procedure: Before the pupils discuss the questions on the page, the teacher should be sure that they have a clear understanding of the concepts listed in the lesson plan for page 10. Have them read all the questions, so that they will know what they are to do. Then have them answer and discuss each question individually. Most of the animals shown on this page, or animals obviously comparable to them in structure, have been presented in food-getting activities on previous pages. Consequently, in the event of disagreement among pupils as to how the questions should be answered, preceding pages should be used for confirmation.

Extending and Enriching Activities:

1. To promote readiness for the understanding of the descriptive terms and the diagrams on pages 14, 16, and 18, ask the children to look at the picture of the Canada goose and trace the area of the light-colored breast. Have them indicate the areas of other body parts and describe their colors. Follow the same technique for the other birds on the page, as well as for the mammals and insects. In describing the mammals and insects use the terms for body parts that are indicated by the labels on pages 16 and 18. In case the colors are not pure, the use of hyphenated color words such as *yellow-red, gray-blue,* etc., should be used. Likewise use the terms *light-brown, dark-brown,* etc.
2. Draw or cut out pictures of animals to make posters or books, captioned "land animals" and "water animals." Include all the animals common to the locality. A third poster should show animals that are equipped to move both on land and in water.
3. Excursions to fields and woods should be made to observe land and water animals. (See Field Trips in the Appendix, page 161.) In cities the parks and museums take the place of country fields and woods.

Pages 14-15

Relation to the Unit: To present a technique for distinguishing one kind of bird from another; to develop the concept that a diagram is designed to show important parts of the object it represents; to review the distinguishing physical characteristics of birds.

Concepts:

A. Birds have certain common distinguishing physical characteristics.
B. Kinds of birds can be identified by color and other distinguishing characteristics of body structure.
C. Certain areas of a bird's body can be distinguished by their general shape and color.

Information for the Teacher: The birds shown on page 15 represent seed-eaters, insect-eaters, and fruit-eaters eating the kinds of foods typical of their diet. Their relative actual sizes

may be judged by the size of the bluejay, which is eleven and one-half inches from its head to the tip of its tail.

The general ranges of these birds are as follows:

Cedar waxwing: temperate parts of Canada as far north as Hudson Bay. It migrates to the United States and Mexico for the winter.

Bluebird: southern Canada and the United States east of the Rockies and southward to the Gulf of Mexico. Variant forms with slight differences in size and color are found in the Prairie Provinces and British Columbia.

House wren: southeastern Canada and the eastern United States. It winters in the southern United States. Many related species are found in other parts of Canada.

Meadow lark: southeastern Canada and the eastern United States. The western meadow lark occurs in the Prairie Provinces.

Bluejay: southern Canada and most of the United States, west to the Prairie Provinces. It prefers forested areas in summer, and often winters in southern Canada.

Song sparrow: southern Canada and most of the United States, and in the west as far north as Alaska. It often winters in southern Canada.

Downy woodpecker: eastern Canada and United States, and the southern Prairie Provinces west to Alberta.

Redheaded woodpecker: eastern Canada and United States, and the southern Prairie Provinces and British Columbia. It is migratory in the northern part of its range.

Procedure: Before these pages are presented, the pupils should review the following physical characteristics that distinguish birds as one of the large groups of animals:

1. Birds are covered with feathers.
2. Birds have two legs.
3. Birds have two wings.

Before opening their books, the children should give the names of birds that are common to their locality. Following a field trip to observe birds the teacher may ask such questions as, "How did you know that you saw a bluebird and not a bluejay?" Answers to this question should include the following responses: "A bluebird has a red breast, while a bluejay has a grayish-white breast." "A bluebird is smaller than a bluejay and has no topknot."

To build readiness for the recognition of printed labels on the diagram, the names of the body parts should be listed on the blackboard as they are used orally by the pupils in describing the birds. Likewise, present the color words *red, blue, brown, gray, yellow, black,* and *white* as the pupils use them. One or two bird descriptions should be written on the board in the form of those on page 14 of *How Do We Know?*

The books should be opened, and the teacher may introduce the diagram by saying: "Look at the two pictures at the top of the page. Are they pictures of the same animal? What animal?" Elicit "robin" rather than "bird." "What is the main difference between the two pictures?" Such responses as "One is in color," "One has just the outside lines" are acceptable. Use the term *outline* to indicate the second picture and explain its meaning. Then ask, "How can you be sure that the outline picture shows the same bird as the color picture?" Have the pupils compare the general shape of the two pictures and see the similarities of bill, head, wing, tail, and foot structures.

To develop the meanings of the words *diagram* and *label,* say: "The picture in outline is called a *diagram.* A diagram is a picture that is used to show parts of a thing. Usually each part of a diagram has a name printed on it. The printed name is called a *label.* Are there any labels on this diagram? Let us read some of them."

Have the pupils indicate the outline of the wing area and read the label *wing.* They should continue the procedure with the other parts. Next they should compare the diagram with the color picture of the robin, identifying the different body areas and their colors.

Call attention to the birds on page 15 and help the pupils identify each one with the printed name. Have them give the names of the birds which are largely blue and those which are largely brown. Next ask the pupils to point out distinguishing characteristics that make one kind of blue or brown bird different from all other blue or brown ones.

Following this activity the children should examine the birds on page 15 to find one that

answers all points of the first description on page 14. Point out that if they do not read the whole description, they may choose the wrong bird, since there is more than one brown bird.

Before the study of pages 14-15 is continued, explain that although the diagram shows a robin, it will serve to represent the body parts of other birds as well.

The pupils should read the other two descriptions on page 14, using the diagram to identify the birds described. Differences of opinion should be justified by reference to the description and the diagram.

Since only three of the eight birds on page 15 are described on page 14, the pupils may take turns describing one of the remaining birds for the other members of the group to identify.

Extending and Enriching Activities:

1. These pages will give ample opportunity to review many of the major concepts about birds that were presented in the preceding books of the series. They can also be used to review and extend concepts concerning the food habits of birds (meat-eaters and plant-eaters). Care should be exercised, however, to be sure the pupils do not get the erroneous impression that each bird eats only the food pictured with it. If Activity 3 in the lesson plan for pages 8-9 was carried out, the pupils should not make wrong inferences in this respect.
2. Through field trips and the use of reference material pupils should ascertain which of the birds shown on pages 14-15 are common to their locality and should collect or make pictures of them, labelling each one. (In certain geographical regions some kinds of birds, such as the bluebird and the bluejay, have different color markings and vary in size.) If, in so far as pupils can determine, any of these birds is not common to the locality, the teacher should explain what is meant by the "natural range" of an animal. (See Information for the Teacher in this lesson plan and reference books on birds in the Bibliography.)
3. A large, labelled diagram of a bird may be made on the blackboard or on a large sheet of paper. One of the pupils may describe birds common to the locality, pointing to the body part on the diagram as it is described, and the other pupils may guess the name of the bird.
4. Additional work in diagramming may be done at this time or in conjunction with later pages if the teacher feels it advisable. Diagrams commonly enclosed with knockdown toys may be examined as an aid in understanding that the main function of the diagram is to explain.

Pages 16-17

Relation to the Unit: To present a technique for distinguishing one kind of mammal from another; to extend experience in the interpretation of diagrams; to review the distinguishing physical characteristics of mammals.

Concepts:

A. Mammals have certain common distinguishing physical characteristics.

B. Kinds of mammals can be identified by color and other distinguishing characteristics of body structure.

C. Certain areas of a mammal's body can be distinguished by their general shape and color.

Information for the Teacher: The chipmunk is the eastern species, with two white stripes and five black stripes. Its length is ten inches. Chipmunks feed largely on grain, nuts, and other seeds.

The actual size of an adult muskrat is twenty-one inches including the tail, and it weighs as much as two and one-fourth pounds. The hind feet are webbed.

The deer mouse is usually a little larger than the house mouse. It has very large ears and a long, pointed nose.

The relative sizes of the other animals may be roughly estimated by comparing them with the raccoon. A full-grown raccoon is about two feet long excluding the tail, is about ten inches high, and weighs as much as twenty-five pounds.

The general ranges and food habits of these animals are as follows:

Muskrat: along the streams and marshy areas of most of North America. Its food consists of plants and small shellfish.

Weasel (common): most of North America.

This is one of the species that change color with the seasons. In winter the fur is white with the exception of the tip of the tail. Small mammals and birds largely compose its diet.

Deer mouse (white-footed): most of the continent. Its main foods are seeds and nuts, but its diet also includes snails and insects.

Mink: all over the northern part of North America. Its habitat is generally in the vicinity of water. It feeds on water animals and any land mammals it can catch.

Ground hog (eastern woodchuck): eastern and central North America as far west as the Prairie Provinces. It is largely a plant eater.

Fox squirrel: eastern and central North America. It eats the eggs and young of birds as well as nuts and other seeds.

Raccoon: most of North America. It is an omnivorous animal. Its diet includes crayfish, grains, fruits, fish, insects, frogs, birds, mice, and earthworms.

Virginia oppossum: all of the eastern United States, but seen only occasionally in Canada in a limited area in southwestern Ontario. The opossum is shown eating its favorite food, the fruit of the persimmon tree, but it eats almost anything it can obtain, animal or vegetable.

Procedure: Before presenting the diagram of a mammal, a preliminary discussion similar to that suggested for page 14 should take place. The procedure for presenting this diagram should follow that suggested for the presentation of the diagram of a bird.

Since previous discussions of the distinguishing characteristics of mammals have given oral experience with the term *mammal,* the teacher should now present the printed word. She should ascertain whether the pupils have the following characteristics, presented in previous books of this series, clearly in mind:

1. Mammals emerge from the mother's body in an advanced stage of growth.
2. Mammals have a skin covering of hair or fur.
3. Mammals in infancy drink milk from the mother's body.

Before the descriptions on page 16 are read, each mammal on page 17 should be identified with its label. Interesting facts given in the Information for the Teacher section of this lesson plan may be brought out during the discussion.

Point out that the colors of mammals are mixed and that whether they are brownish, grayish, or yellowish, the general color tone determines their designation as brown, gray, or yellow. For example, the yellow of the weasel's belly differs in shade from that of the squirrel's belly, yet in a general description the word *yellow* may be used for both. Since color printing in the books may vary, the black tip of the weasel's tail may not be so clearly defined in some books as in others. Therefore, the teacher should give help if pupils are not able to identify the weasel as the mammal fitting the first description on page 16.

Extending and Enriching Activities:

1. The bird game suggested in Activity 3, page 20, may be adapted to fit mammals. Reference books on mammals may be used to obtain subjects for this game. (See the Bibliography.)
2. The pupils should check preceding pages to see which mammals illustrated on page 17 have been previously shown. They should write the name of each mammal and list under it all the kinds of food it eats. These lists should be studied by the pupils in order to determine whether each mammal shown should be classified as a meat-eater or a plant-eater.
3. Lists of the characteristics of mammals and birds should be contrasted in order to stress the differences between these two groups of animals.
4. Make additions and any corrections needed on the chart that was suggested in Activity 3 for pages 8 and 9.

Pages 18-19

Relation to the Unit: To present a technique for distinguishing one kind of insect from another kind; to extend experience in interpreting diagrams.

Concepts:

A. All insects have six legs and two feelers or antennae.
B. Kinds of insects can be identified by color and other distinguishing characteristics of body structure.

C. An insect's body has three distinct sections that can be distinguished by their general shape and color and by the structures attached to them.

Information for the Teacher: The life sizes of the insects shown on page 19 are as follows: grasshopper, bumblebee, monarch butterfly, dragonfly, and lacewing fly about the same size as their illustrations; tiger beetle and potato beetle about two-thirds picture size; ladybug (ladybird beetle) about one-third picture size.

The grasshopper is the common short-horned species and is shown on a blade of a corn plant.

The bumblebee is an important insect in the production of clover seed, for it fertilizes the flowers. The females live in the ground during winter and lay eggs in the spring.

The monarch butterfly is shown on its favorite food plant, the milkweed blossom. The monarchs migrate and often are seen in great numbers during their migratory flights.

The potato beetle is the Colorado species.

The dragonfly is the species known as water prince. Its typical food is the mosquito, which it captures in midair with its long, jointed legs.

The tiger beetle is a species similar to several species found in Canada. They have sharp jaws and are fierce food-hunters—hence their name. They suck the blood of insect victims.

The ladybug eats plant lice and scale insects. It varies in color and pattern on the wing covers. Most beetles have hard cases that cover the wings when not in flight.

The lacewing fly feeds on plant lice.

The word *insect* should not be erroneously used. All insects have three distinct divisions of the body, as shown in the diagram on page 18, and six legs which are attached to the thorax. The thorax usually bears the wings, and the feelers are attached to the head. Use books such as *Animals Without Backbones,* by Ralph Buchsbaum (see the Bibliography), for detailed descriptions and diagrams of an insect's anatomy, including the respiratory system. Thus the pupils who are apt to use the terms *bug* and *insect* interchangeably should be led to observe that many so-called "bugs" cannot be classified as insects because their external structures do not resemble those of insects.

Some insects resemble their parents when they hatch from the eggs, but most of them do not; the latter have various changes of form before attaining the adult stage.

Procedure: As a preparation for the study of the external structure of insects, the teacher should bring a mounted specimen, such as a grasshopper, a butterfly, or a dragonfly, into the classroom. However, if the pupils have already made insect collections, one of their specimens may be used instead. Have the pupils discuss the variations in size, shape, and color which they may have observed in these familiar insects.

Use the specimen to point out that true insects have three divisions of the body—thorax, abdomen, and head. These terms were presented orally in the *Guidebook* for *All Around Us,* the preceding book of this series, but should be thoroughly reviewed at this point as preparation for the reading of the printed labels on the diagram. Be sure to make clear to the pupils that the abdomen is the whole section and not just the underneath part corresponding to the belly in mammals. This concept must be clearly grasped, so that pupils will not call the top portion of the abdomen the "back."

In some of the examples on page 19 there is no clear division between the head and thorax or between the thorax and abdomen. The teacher should call attention to this fact and point out that the head is the section to which the feelers are attached and the thorax is the section to which the legs are attached. Specimens of beetles (see Activity 1 in this lesson plan) should be obtained to make clear that the abdominal section is separate from the wings that cover it.

Review and list the common distinguishing characteristics of insects:

1. Insects have six legs.
2. Insects have three parts to their bodies.
3. Insects have two feelers, or antennae.

After the books are opened, present the diagram and page 19, following the procedure suggested for pages 14-15. Make sure that pupils notice the types of food (vegetable and animal) being eaten.

While mouth parts are not clearly shown on pages 18-19, the pupils will infer that all insects have them.

Extending and Enriching Activities:

1. If the season permits, start a collection of insects. The Appendix, page 157, gives detailed directions for the preparation of a jar in which insects can be killed quickly and without danger to the pupils who handle it. If the pupils are unable to make an insect collection, one should be borrowed if possible from older pupils; or museums may be visited to examine specimens. The insects should be studied and compared in terms of the diagram.
2. The bird game suggested in Activity 3, page 20, may be adapted to fit insects.
3. Information concerning the harm and the good which various insects do, particularly those shown on page 19, should be obtained and recorded on posters or in booklets. In connection with this activity, reference books, lantern slides, and moving pictures may be used. (See the Bibliography.)

Pages 20-21

Relation to the Unit: To present in detail mouth structures in relation to the food habits of animals.

Concepts:

A. Specialized tongues fit some animals to obtain food that would otherwise be hard or impossible to get.
B. Specialized jaw structures fit some animals to eat certain kinds of food.
C. The bills of birds fit them to secure the food they eat.

Information for the Teacher: The first animal on page 20 is the common toad. Toads, like frogs, are cold-blooded; and they hibernate, burying themselves in the ground at the beginning of cold weather.

The oyster catcher is a bird common to the Pacific coastal areas and to the Atlantic coast of the southern United States. Its length is twenty-one inches from head to tail. It has a sharp, wedge-shaped bill, which it uses to force apart the shells of oysters, clams, and various shellfish. Marine worms and insects also form part of the diet of this bird.

The tiger swallowtail butterfly is widespread, occurring from the Atlantic to the Pacific and from Canada to Florida. It is particularly prevalent in the south. A butterfly has a long tongue (proboscis) that has hollow tubes through which nectar is sucked from flowers.

The garter snake, common to all parts of southern Canada, grows to about one yard in length. Garter snakes are extremely variable in colors and patterns. They feed on earthworms, frogs, and toads, and never eat small mammals as most other snakes do. The snake's prey in the picture is a leopard frog. The lower jaw of a snake is divided, and the two halves are joined by elastic ligaments. The bones supporting the lower jaw are movable on the skull, thus permitting the swallowing of an animal whose diameter is considerably greater than that of the snake's normal mouth opening. The young of garter snakes are born alive instead of being hatched from eggs as are the young of many other kinds of snakes.

The grasshopper has grinding jaws, and the plants it eats are held between the jaws by the upper and lower lips. Grasshoppers vary in color. The adults complete the life cycle in the fall; at this time the females deposit eggs in the soil. The eggs hatch in the spring; and the young, unlike most insects, resemble the adult when hatched.

The yellow-shafted flicker is common in eastern Canada as far north as the tree line. Its length is about twelve inches. (The red-shafted flicker is common in the West.) A flicker's tongue is spearlike and can be thrust outward two and one-half inches beyond the end of the bill. It is covered with a sticky saliva which catches and holds ants and other small insects.

The two-lined salamander is found in damp places in eastern North America. Other species are found throughout southern Canada. It is about four inches long. The salamander's tongue is attached to the mouth by a central stem that is topped by a caplike structure. The cap can be thrust out to grasp food and to push it up against the teeth, which are in the roof of the mouth. Snails and small crustaceans, worms, and insects compose the salamander's food.

The ducks are mallards, male and female. Domesticated or wild, they range over most of the northern hemisphere. The mallard is omnivorous, usually feeding in shallow water, and is particularly fond of wild rice. It has a broad, flat bill with strainers at the sides, which it uses as a sieve to separate mud and other foreign matter from its food.

Procedure: Before opening the book to pages 20-21, discuss the importance of the mouth in getting food. The teeth, tongue, and lips should be recognized as mouth parts, and the function of each part should be stressed. By the use of health textbooks, diagrams and pictures found in advertisements of various dentifrices, and by inspection of their own mouths the pupils should be made aware of the different kinds of teeth in the human mouth. They should count (in diagrams or pictures) the number of each kind of teeth that an adult has and compare them with their own. When the difference between "baby teeth" and the teeth of an adult has been noted, discuss how the biting teeth, cutting teeth, and molars vary in shape.

Then introduce pages 20-21 of *How Do We Know?* by saying: "All animals do not have the same kind of mouth. Probably it is very fortunate that they do not, for if that were true, many of them would have trouble getting the particular foods shown on pages 20-21. These pictures show how animals with different kinds of mouths get certain kinds of foods."

The pupils should interpret the action sequence in each of the four rows on page 20 in order to compare and contrast the different types of mouths. During the discussion the mouth structure of each animal should be related to the food the animal is eating. Thus, the pupils should perceive that because of its particular type of tongue the toad is able to catch flies without making a body motion that would warn a fly in time for it to escape.

If at all possible, bring a toad into the classroom for observation. Place it in a screened box in which flies have been released. The speed with which the tongue flicks out and secures food prevents one from seeing how the tongue actually works, but the pupils can see that it is used to grab food. (If the local library has a 1940 file of *Life* magazine, see the October 14 number, page 128, for pictures of the tongue in action. The March 1945 number of *Natural History* also has good camera pictures of the tongue's action.)

Since many inland children have never seen a live oyster in its shell, the teacher should, if possible, obtain an unopened oyster and bring it to the classroom so that the difficulty of opening the shell may be demonstrated. Thus the pupils will understand how the wedge-shaped bill of the oyster catcher assists it in opening oysters.

The advantage of the butterfly's tongue (proboscis) over other types of mouth parts in obtaining nectar should be brought out. The teacher should be sure that the pupils understand what nectar is. Bring deep-throated and shallow-throated flowers for the pupils to dissect. Then ask them if they think any other animal on page 20 could get nectar from flowers. If a pupil suggests that the pointed tongue of the toad or the long bill of the oyster catcher could obtain nectar, explain that the tongue of the butterfly has hollow tubes through which the nectar is sucked from the flower.

Stress the fact that while the snake's mouth is normally smaller than the frog, it stretches to take in animals larger than its normal size. (See the information section of this lesson plan.) The teeth of the snake are not shown, but pictures can be obtained to show how the backward slant of the teeth prevents the escape of an animal that is being swallowed. The teeth are not used for chewing, for the snake swallows its prey whole. Explain that garter snakes are harmless to people.

The close-up pictures of mouths on the right of page 21 require the same type of treatment as that suggested for page 20; at all times the discussion should be related to the kinds of foods eaten. These various types of mouth structures are not particularly important in themselves. They assume value only when the relation of the mouth parts to the food eaten is stressed. The information section of this lesson plan provides leads for discussing the structures shown in the first three rows. In the fourth row, the strainers along the edges of a duck's bill can be clearly seen in the close-up picture. Point out the function of these strainers.

Examine the mouth structures of birds and mammals on preceding pages of *How Do We Know?* and discuss how the mouth parts are related to the type of food each animal eats.

Extending and Enriching Activities:

1. Obtain a plaster cast of a human mouth from a dentist. Point out the various kinds of teeth and discuss how each kind is used when we eat food. While it is not necessary that the pupils should learn the names of

the teeth, they should perceive that the pointed teeth (canines) are especially suited for tearing flesh, while the large, flat-topped teeth in the back (molars) are especially suited for grinding. This activity will be very helpful in introducing the work of pages 22-23, and it may be correlated with health teaching.

2. Bring a pet cat or dog to class and carefully examine its mouth, particularly the teeth. Great care should be taken not to injure the animal or expose the children to harm. Usually the mouth can be adequately examined by merely lifting the lips; but, if preferred, a small stick, such as a clothespin, can be inserted between the animal's jaws without discomfort to the animal or harm to the pupils. Heavy gloves should be worn as a safety precaution while examining the pet's mouth.
3. The distinguishing characteristics of mammals, insects, and birds may be reviewed in order to stress the fact that the toad, snake, and salamander do not belong in any of the three groups. Explain that the toad and salamander belong to a group of animals that are fitted to spend certain periods of their lives in water and certain periods on land. The term *amphibian* may be presented. Explain also that the frog is an amphibian. The term *reptile* may be presented as the name of the group of animals to which the snake belongs. The body covering of scales is the only distinguishing characteristic that should be stressed at this point. The teacher should explain that turtles have shells made up of hardened scales and therefore they, too, are classified as reptiles. An examination of the shells of the small species of turtles in the aquarium and terrarium will show that they are made up of scales.

Page 22

Relation to the Unit: To develop the concept that the kind of food an animal eats is (in part) dependent on its mouth structure.

Concepts:

A. Meat-eaters (carnivorous animals) have long, pointed front teeth (canines) and flattened back teeth (pre-molars and molars) which fit them for tearing and grinding raw flesh.

B. Some plant-eaters (herbivorous animals) have long, sharp, chisel-like teeth which fit them for gnawing tough, woody plants.

C. Animals that eat both meat and plants (omnivorous animals) have teeth which fit them for biting and chewing plants and for tearing and grinding raw flesh.

Information for the Teacher: A good reference book such as *Fundamentals of Biology,* by Arthur W. Haupt, or *American Mammals,* by W. J. Hamilton, Jr. (see the Bibliography, pages 164-172), should be used by the teacher in order to answer pupils' questions that go beyond the scope of this book.

Hoofed animals (ungulates), which include swine, horses, elephants, and the ruminants (see Information for the Teacher for page 23), have front teeth that are fitted for cropping and flattened molars and pre-molars for grinding.

Procedure: After examining the pictures, the pupils will see that the animals shown have been previously introduced in *How Do We Know?* Have them find the page on which each animal is pictured and note the kind of food (animal or plant) that is being eaten.

Then have the text read. It is important that the pupils be familiar with the food preferences of each animal before they attempt to answer the questions regarding teeth. Then the pupils should observe the relationship between the food eaten by each animal, and the type of teeth it has.

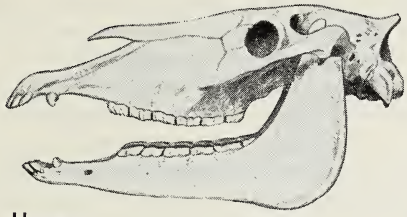
Page 23

Relation to the Unit: To develop ability to make inferences based on observed facts.

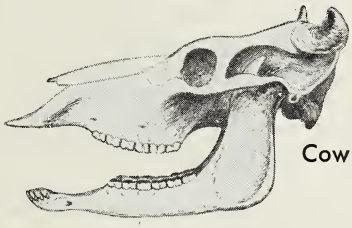
Information for the Teacher: The animals shown, from left to right, are as follows: rabbit, opossum, fox; skunk, mouse; deer, cow; tiger, wolf.

Ruminants (animals that chew cuds) such as cattle, goats, deer, giraffes, and camels have no incisors in the upper jaw, but they have both upper and lower molars and pre-molars. Plants are pulled into the mouth by the tongue, and then a forward thrust of the head cuts off the plants against the incisors in the lower jaw.

The food is swallowed without being chewed and passes into one of the four separate divisions of the stomach. Food is later regurgitated and chewed thoroughly. It is then swallowed and passes into the other three divisions of the stomach.



Horse



Cow

Procedure: The pupils should look at the teeth of each animal and then see if they resemble the teeth of any animal on page 22. By recalling the type of food eaten by animals with similar types of teeth, the pupils should infer the kinds of food these animals can eat. Great care should be taken to discourage guessing in following the directions given on the page. Each child should be ready to justify his decision as to which animals eat other animals, which eat plants, and which eat both plants and animals. The terms *carnivorous, herbivorous,* and *omnivorous* need not be introduced at all; but if the interest and maturity of the pupils give evidence that correct associations of meaning will be made, the terms may be presented at this point.

Because a realistic picture cannot show the absence of upper incisors in the deer and the cow, most pupils will conclude that the teeth of these animals are like those of a horse, especially since a cow is shown grazing with the horse on page 9. Therefore, the teacher should show or draw diagrams of skulls like the ones on this page in order to explain the differences between the teeth of a cow and deer and those of a horse.

In the event of disagreement over the foods that can be eaten by each animal, the pupils should look back through their books for pictures of the same or similar animals with the same general tooth structures. The foods these animals are eating should be noted. Thus by observing that the rabbit, mouse, beaver, chipmunk, and squirrel all have gnawing teeth, the children will be led to infer that all of them eat the same general type of food. When the pupils are in accord, they should make a list classifying each animal according to the type of food it largely eats. For example:

rabbit—plant-eater
opossum—plant- and meat-eater
fox—meat-eater

This list should be corrected if later information shows that any of the classifications are wrong.

Extending and Enriching Activities:

1. Many children will be interested in a detailed comparison of the mouths of grazing animals and gnawing animals. Pictures, drawings, or photographs in poster or booklet form showing the teeth of such animals may be used to summarize the study of mouth parts in relation to foods eaten. If animals such as white mice, guinea pigs, or rabbits are available (see the Appendix, page 160, the eating habits of gnawing animals may be observed.
2. If the pupils have not already examined the structure and arrangement of the teeth of human beings, as suggested on page 24, they should do so as an extending activity.
3. To avoid too much emphasis being put on teeth alone, the teacher may lead the children to discuss the other mouth parts that are involved in food-getting. The discussion should include such parts as the lips, tongue, throat, jaws, etc. The mouth structures of the animals shown on page 23 should be compared with the mouth parts of the animals shown on pages 20-21. The relation of the mouth parts to the foods eaten should be stressed.

Pages 24-25

Relation to the Unit: To extend awareness of the relationship of food-getting structures to food habits; to promote ability to analyze and to perceive likenesses and differences.

Concept:
Specialized foot structures fit some animals to grasp food efficiently and to get it into the mouth.

Information for the Teacher: On page 24 the following animals are shown: broad-winged hawk, muskrat, gray squirrel, water strider (catching a stone fly). Their life sizes are as follows: hawk, fourteen inches long, with wing-spread of about thirty-six inches; muskrat, about twenty-one inches including the tail; squirrel, about eighteen inches in length including the tail; water strider, about one inch long.

Muskrats, like beavers, live along streams and in ponds and marshes; and their homes are similar in construction.

On page 25 the parrot and crabs are the only unfamiliar animals. The crabs are of the species known as the ghost or sand crab. Their larger claw is used principally for warding off other food-hunters, while the smaller claw is used for tearing the flesh of dead fish and for grasping other food, such as slugs and worms. The crab's eyes are on stalks and are retractile. The size of the crab can be gauged by the sizes of the clam and the snail shell.

Procedure: The teacher may introduce page 24 as follows: "We have been talking about mouths and how they help different kinds of animals eat food, but there is something that many animals must do before they can eat their food. What must they do? (Many animals must pursue and catch their food before they can eat.) What parts of their bodies then are very important in food-getting?" (feet)

Then say, "Turn to page 24 and find out how each animal is using its feet to get food." Instruct the pupils to interpret the pictured action sequence in each row to determine just how the foot and leg structures are functioning in food-getting.

Thus the pupils should perceive that the talons of the hawk assist it not only in striking and grasping the chipmunk but also in carrying it; the webbed hind feet of the muskrat assist it in swimming to the water plant, and its front paws hold the root while it gnaws and eats. Explain that nonretractile claws, or toenails, help the muskrat to dig for roots and enable the squirrel to climb trees.

While discussing the last row of pictures, bring out the fact that the length of the leg sections that touch the water is sufficient to keep the water strider afloat and to enable it to skate across the water. The jointed front legs can be used as skillfully as hands in snatching food.

Before page 25 is presented, bring out that feet are vital parts in food-getting among plant-eaters as well as among meat-eaters.

Page 25 continues the study of the importance of feet and claws in obtaining food. In each case a detailed close-up of the foot structure of the animal is presented so that a more thorough study can be made. The pupils should look at the picture of each animal, then determine what kind of food it is eating and how the foot structure is aiding the animal in obtaining food. Next the detailed drawing of the foot structures should be studied, and the children should decide how these structures are fitted to assist the animal in obtaining its food. Ask, "How is the raccoon's hind foot different from its front foot? Are they as different from each other as our feet and hands?" The hind-foot structure of the raccoon may be compared with the foot of a human being, and the long, jointed toes of its forefoot may be compared with human fingers.

The ways in which the foot structures of these animals are being used should be compared with those of the various animals shown on preceding pages. For example: the parrot's feet may be compared with those of the hawk on page 24, with those of the flickers on page 21, and with those of the birds shown on pages 13 and 15. The forefeet and hind feet of the raccoon and the opossum may be compared with those of the squirrel and the muskrat on page 24.

Extending and Enriching Activities:

1. Read stories about squirrels, muskrats, raccoons, opossums, parrots, etc. (see the Bibliography, pages 164-172), that will reveal additional information concerning the food habits of these animals.
2. Discuss other body parts that are important in food-getting. These should include eyes, ears, antennae, and other specialized parts, such as the spinnerets of the spider, the elephant's trunk, the giraffe's long neck, the tentacles of the octopus, the long legs of the waders, and the tail of the opossum.

3. Stress the importance of locomotion in food-getting. Ask the pupils if they can find in Unit 1 an animal that can get its food without moving. The pupils should perceive that ability to move about is vitally important in obtaining both plant and animal food.
4. The external structure of a crab should be compared with that of the crayfish on page 11, with the fish on pages 11 and 12, and with the turtles on page 12. On the basis of such comparisons the pupils should decide which animals the crab most resembles.
5. Make up descriptive riddles in order to summarize the work on food-getting structures. The pupils might compose riddles similar to the following:

   I am a mammal.
   I live on land.
   I am a plant-eater.
   I eat the leaves of trees as well as grass.
   I can reach the tree leaves even though I do not have a long neck.
   What am I? (Elephant)

Pages 26-27

Relation to the Unit: To demonstrate that body structures can be classified as primary or secondary according to the ways in which they are used in food-getting; to develop ability to interpret diagrams with keyed symbols.

Concepts:

A. Structures that enable animals to seize and get food into their bodies are of primary importance in food-getting.
B. Structures that enable animals to locate and get to food are of secondary importance in food-getting.

Information for the Teacher: The animals on page 26 are black spider monkeys, praying mantis, little brown bat; on page 27, great blue heron, common mole, barn owl.

Their life sizes are as follows: black spider monkey, about eighteen inches long; praying mantis, two or three inches; little brown bat, about three and one-half inches including the tail; great blue heron, forty-two to fifty inches; common mole, about six inches; barn owl, eighteen inches.

The little brown bat uses its mouth to catch mosquitoes and other insects for food. It has tiny, sharp teeth that enable it to capture insects with ease. Bats fly about at night on their thin wings, which are made of soft, sensitive membranes joining the forearms and hind feet. The wings fold like a pocketknife, and some measure as much as nine inches from tip to tip. Bats are not blind, as is commonly supposed. Their eyes are small and keenly observant. The bat is not fitted for walking, since its knees bend backward, but it can use its teeth as an aid in climbing.

For digging the tunnels which serve as its hunting ground, the common mole is equipped with a wedge-shaped head and huge forefeet with long nails. Its eyes are about the size of a pinhead, and its ears are also small but very sensitive.

Procedure: On pages 26-27 the next step in diagram-reading is presented, for here the parts are numbered and the pupil is required to read the accompanying key in order to understand the diagram. Before presenting these pages, review pages 14, 16, and 18, where diagrams were used to identify structural parts.

When the books have been opened to pages 26-27, the teacher may introduce the lesson as follows: "We have talked about the importance of mouths and feet in the getting of food. What other parts of the body did we decide were often important in food-getting?" (legs, wings, tail, neck, eyes, and ears.)

Call attention to the first diagram and point out that there is not enough room to put the names of the body parts on the diagram. Consequently, the parts are given numbers, and the names that the numbers represent are listed near the diagram. The numbers should be translated into part names before any detailed study is undertaken.

Pupils should then identify the animals at the left as monkeys and decide what is being eaten. Next they should study the accompanying diagram and decide how each numbered part assists a monkey in getting food.

It should be perceived that the structures which enable an animal to seize food, to get it into its body, and to eat it are the chief food-getting structures; and the pupils should be able to identify them as such. Likewise, pupils should be able to identify secondary structures as those which are helpful in locating food and getting to it.

Thus the chief food-getting structures in the first picture are the forefoot, or hand, and the mouth. The structures that merely aid in getting food are the hind foot, which assists the monkey in climbing and walking along tree limbs, and the tail, which enables the animal to attain a position that brings the banana within reach of its hand. The importance of the eyes as an aid in locating food should be stressed even though eyes are not given a number on the diagrams. Present the other examples with similar procedures. In the picture of the mantis call attention to the barbed foreleg that clutches the prey and holds it securely and the long sections that serve as feet on the other two pairs of legs. The large eyes of the mantis also should be noted.

The pupils should notice that the chief food-getting part of the bat is its mouth, for it is equipped with fine, sharp teeth on which the insects that form the bat's food are impaled.

During the study of the mole explain that the picture shows how the mole's tunnel would look if one side of it were cut away. Ask: "How do you think the mole makes its tunnel? How are the front feet fitted to help the mole push its way through the soil? How does the shape of its nose help the mole? See how the teeth resemble the teeth of a comb. How do teeth like these help the mole catch insects and earthworms that it is unable to see? What animal on page 26 has teeth very much like these?"

At the close of this lesson have the pupils turn to preceding pages and find animals that use their food-getting structures in ways that are somewhat similar to those of each of the animals on pages 26-27. Thus the pupils should perceive that the opossum uses its tail in somewhat the same way that the monkey does; the hawk uses its wings, talons, and beak much as the owl does; etc. The food-getting structures of these other animals may then be classified as to which are of chief importance and which are secondary.

Extending and Enriching Activities:

1. Draw on the blackboard a diagram of a mammal or bird and number the body parts. The pupils should find that animal in their books and then dictate the key to be placed near the diagram. For example, "Part 1 is the nose. Part 2 is the throat," etc.
2. Make numbered identification keys for diagrams of any knockdown toys used in Activity 4 of the lesson plans for pages 14-15.

Pages 28-29

Relation to the Unit: To apply concepts concerning the relationship of body structures to food-getting in the discovery and correction of errors.

Procedure: Pages 28-29, while amusing, are designed to give opportunity for the application of knowledge concerning the functions of structures and their relation to food-getting.

All the animals cartooned on these two pages have appeared in realistic pictures on preceding pages. The pupils are to analyze each picture and determine what is wrong with it. For example: webbed feet instead of talons would prevent the hawk from grasping the chipmunk; the broad bill on the woodpecker would keep it from getting any insects that might be in the bark of the tree; etc. Next they should describe fully the correct structure and explain how it helps the animal obtain food.

For added enjoyment and value, ask the pupils to name an animal that each mismatched structure would fit.

Extending and Enriching Activities:

1. The pupils should engage in an activity that serves to summarize food-getting and food-getting structures. An exhibit may be prepared from the posters, picture-stories, booklets, diagrams, etc., that have been made during the progress of the unit. It may cover such broad topics as carnivorous, herbivorous, and omnivorous animals and how they get their food, as well as more specialized topics such as animals that gnaw, animals that graze, etc. Committees should be appointed to evaluate the projects and to choose the ones that have the most worth to the exhibit.
2. Making a frieze of original cartoons similar to the ones on pages 28-29 would be an interesting and pleasurable activity. Regardless of the trend the pupils' interest takes, the teacher should be sure they clearly understand the relation of body structures to food-getting.

Pages 30-31

Relation to the Unit: To present the relationship of animal population to food supply; to develop ability to make inferences from related facts.

Concepts:

A. Some animals can find food throughout the year and are active in all seasons.

B. The supply of plants affects the number of plant-eating animals found in a given locality.

C. The number of plant-eating animals in a given locality affects the number of flesh-eating animals found there.

D. Some animals migrate in the spring and autumn to other localities or zones.

E. Some animals complete the life cycle in autumn and die.

Information for the Teacher: From left to right, the group of animals on the left of the spring scene on page 30 includes a bluejay, screech owl, black-capped chickadee, cardinal, gray squirrel, deer mouse, cottontail rabbit, and a raccoon. On the right-hand side are a yellow-bellied sapsucker, myrtle warbler, robin, bluebird, downy woodpecker, quail, red-winged blackbird, woodchuck, and a weasel.

On the left side of the summer scene the group includes a black-capped chickadee with young, screech owl, bluejay, Cecropia moth, brown thrasher, squirrel, meadow lark, cardinal, deer mouse, rabbit with young, toad, and a raccoon with young. On the right-hand side are a tiger swallowtail butterfly, dragonfly, downy woodpecker, robin with young, red-winged blackbird, bluebird with young, chipmunk, weasel, scarlet tanager, bumblebee, locust, snake, woodchuck, quail with young, frog, and an opossum with young.

On page 31 the group on the left side of the autumn scene includes a black-capped chickadee, downy woodpecker, ruby-crowned kinglet, cardinal, pigeon hawk, Wilson snipe, quail, weasel, deer mouse, and mallard ducks (male and female). On the right-hand side are a bluejay, screech owl, red-winged blackbird, myrtle warbler, rabbit, squirrel, and a raccoon.

The group on the left side of the winter scene includes a black-capped chickadee, downy woodpeckers, cardinal, deer mouse, purple finch, quails, juncos, snow bunting, tree sparrow, and a weasel. On the right-hand side are a screech owl, squirrel, bluejay, northern shrike, rabbit, and a raccoon.

Procedure: While these two pages afford a review of the sequence of the four seasons and their physical aspects, the primary emphasis should be on the relation of the seasonal food supply to animal population.

The teacher may introduce the new topic by saying: "We never have much trouble getting our food, do we? In the spring and summer we can raise our own food. What are some of the early spring vegetables we raise? What are some of the summer vegetables we raise? How many of you have eaten tomatoes in the winter? How did we get them?

"What season of the year is it now? What animals do we see where we live? What do these animals find to eat? Do you think that animals ever have trouble getting their food? Turn to pages 30-31 and see what we can learn about the food supply of animals."

Review the names of the seasons and after the pupils have studied the physical aspects of each of the four scenes, decide which season each scene represents. Then say, "The animals that are arranged around the first picture are some of the common ones seen during spring." Be sure the children understand that these animals are merely a representative selection. Elicit the names of the animals, giving help when needed and referring to previous pages of *How Do We Know?* if necessary.

After the text under the picture has been read, continue the discussion by asking questions such as the following: "Do you think these are all the animals that are seen in the spring? What other animals do we see during spring in our locality? What does each of these animals eat? How can we find out if we are not sure?" As the pupils name the food preferences of each animal, they should determine whether those foods can be found in spring and whether they are shown in the picture. (Teachers in areas other than the north temperate zone will, of course, call attention to the fact that some of the animals on these pages are not common in their regions.)

Continue with questions about the next picture. "What season is shown in the second picture on page 30? What animals do you see around the summer picture? Are some of them the same kinds that you saw in the spring picture? Which are they? Find animals which were not in the spring picture." If the pupils do not immediately call attention to the large numbers of young, say: "Look at the robin in the spring picture. Now find a robin in the summer picture and tell what you see with it. What other animals in the spring picture are shown with their babies in the summer picture?"

If the children point out that not all the animals shown in the spring picture have their young with them in the summer picture, suggest that the pupils find out when these animals do have their young, so that the class can decide whether the babies should be in the picture or whether they have already grown to the adult stage. (See the Bibliography, pages 164-172, for reference books.)

Guide the pupils in making generalizations with questions such as "In which season do the greatest number and variety of animals appear? In which season is there the most food for animals? How can you tell?" Pupils should generalize that (1) there are more plants in summer than in spring, and so there is more food in summer for plant-eaters; (2) since there are more plant-eaters in summer than in any other season, there is also more food for meat-eaters, and consequently there is an increase in the number of meat-eaters. Thus an elementary concept of the "balance of nature" will be developed.

Continue in the same manner with the presentation of the remaining pictures, discussing the characteristics of each season, the variety and extent of the animal population, and the variety and extent of the food supply.

To clarify and stress generalizations regarding the relationship of animal population to food supply, say: "Look at the four season pictures again. When is there the most food for animals? When is there the least food for animals? During what season do we see the greatest number of animals? During what season do we see the fewest animals?"

The pupils should note the animals that are common to all four pictures. Call attention to the color change of the weasel from the summer coat to the winter coat and give the pupils an opportunity to make the inference that the white fur makes the animal hard to see in winter so that it can escape its enemies and stalk its food without being seen.

Introduce the idea of migration of animals as follows: "Find the robin in the spring and summer pictures. Can you find the robin in the fall or winter pictures? What has happened to the robin?" Since most children in northern and southern regions are familiar with the fact that birds go south in the fall and north in the spring, this fact will be volunteered.

Ascertain whether the pupils understand that during the winter in the North there is an adequate food supply in the South. Avoid the all-too-common, false conclusions that warmth is the important factor in migration or that robins *decide* to migrate *because* in winter there is not an adequate food supply for them and that owls *decide* not to migrate *because* they can obtain enough food in winter.

Continue with questions such as "Can you find other birds on these pages that migrate in the fall? Which birds shown in the spring picture do not go south? What food do the birds that stay all winter like to eat?" If the pupils do not know or cannot infer that the birds which remain in the North are largely seed-eaters, the teacher should inform them of this fact.

When pages 30-31 have been thoroughly discussed, the teacher may say: "We know that before winter comes, some birds migrate to regions where food is plentiful and that some animals can find enough food in winter without going south. What do you suppose happens to the other animals we saw in the summer picture?" The pupils probably have some knowledge of hibernation, partial hibernation, and food storage. They also may know that many insects complete the life cycle in the fall and die. The teacher may point out on page 30 that such animals as grasshoppers, dragonflies, and most butterflies hatch from eggs and complete their life cycle in one year but that the species endures, since the eggs are laid before the adults die.

Extending and Enriching Activities:

1. A group should be appointed to discover from books and actual observations what

bluejays, cardinals, etc., eat. These findings should be reported to the class. Another group should discover the food preferences of the other animals in the winter picture and report on the food available during winter. Excursions should be made in order to find places where weed seeds and various other seeds are fairly plentiful in winter.

2. A large picture-map may be made to show areas where wild life can find adequate food and shelter during cold winters.
3. Start collecting pictures for Activity 1 in the lesson plan for pages 32-33.

Pages 32-33

Relation to the Unit: To present examples of animals that make specialized adaptations to the scarcity of food in winter.

Concepts:

A. Some animals store food and thus are able to survive the season of food scarcity.

B. Some animals hibernate during protracted cold periods when food is scarce and thus do not need food.

Information for the Teacher: The animals on page 32 are as follows: gray squirrels (storing nuts), California woodpeckers (placing acorns in holes they have drilled); eastern chipmunks (storing acorns); bluejays (burying acorns) and big brown ants (carrying bits of insects and other food).

On page 33 the hibernating animals are as follows: bears in a hollow tree trunk, turtle and frog in the bed of a pond; skunks in the ground; carpenter ants and mourning-cloak butterfly under the loose bark of a tree, and rock rattlesnakes in a natural rock cavity.

Procedure: Pupils should read the text and examine the pictures on page 32. They should identify each animal pictured ("woodpecker" rather than "California woodpecker" may be accepted as a satisfactory identification at this point) and tell what each one is storing. Explain that animals such as the woodpecker, bluejay, and squirrel do not find all the food which they have hidden, nor do they usually hide a sufficient quantity to last all winter. However, what they do store supplements the food they are able to find in winter. The pupils should name other food items each animal is known to eat and additional places where it stores food.

If the maturity of the group warrants, the teacher may bring out the fact that chipmunks are one of the kinds of animals that do not require so much food during winter as during other seasons because they sleep part of the time (partial hibernation). Though occasionally active, they are far less active in winter than during the other seasons and consequently require less food.

Continue with page 33, having the pupils read the text and answer the question. The term *sleep* may be considered a satisfactory answer, provided it is understood that hibernating animals do not waken at the end of each night as people do when they sleep.

The teacher should explain that skunks, bears, woodchucks, raccoons, etc., eat great amounts of food in the fall, and large fat masses are produced in their bodies before they go into hibernation. This fat is used by the body during the animal's hibernating torpor. Frogs go down into the mud at the bottom of ponds to hibernate, while toads burrow into the ground below the frost line. Both breathe through their skins as they lie dormant. Breathing is practically suspended in the case of hibernating snakes and turtles.

While discussing the butterfly, make clear to the pupils that monarch butterflies migrate; other varieties complete their life cycle in the fall; and a few varieties, including the mourning cloak, hibernate until spring.

Stress the fact that there are many kinds of ants and that the two kinds shown on pages 32 and 33 winter in different places. The carpenter ants on page 33 hibernate during cold weather, while ants such as the big brown variety that have nests in the ground are, like the honeybee, merely inactive and live on stored food.

While discussing hibernating insects, bring out that flies and female wasps, hornets, and bumblebees hibernate. The queen and worker honeybees also live through the winter.

Extending and Enriching Activities:

1. Make a poster or series of posters for the particular season during which the lesson is studied. Draw or collect pictures of animals seen in the local environment. Make posters of these pictures and keep a con-

tinuous record on the posters of the dates when the animals were seen. Thus, depending on the season, the last dates will indicate the approximate times of migration or of retirement into winter homes. For example, the dates under the robin picture might indicate that this bird was first seen in the locality on March 15 and that it was seen frequently until October 25. The pupils should also find out which other animals hibernate, partially hibernate, store food, or migrate.

2. Draw or cut out pictures to illustrate legends such as the following:
   a. These birds stay in our town all winter.
   b. These birds will come back to us from the South in spring.
   c. These animals will come out of their winter homes when spring comes.
   d. These animals migrate.
   e. These animals sleep all winter.
   f. These animals store food.
   g. These animals die before winter comes.
   h. These animals can find food in winter.
3. Make life histories of individual animals by drawing or pasting cutout pictures that show their various stages of growth and varying realistic activities. Thus one child may depict the life story of a baby skunk, another the story of a chipmunk, etc. These may be made into books to be read to the class and placed in the science corner for reference.
4. Construct an ant nest and dig up ants to establish a colony for observation. (See the Appendix, page 157.)
5. Make a field trip to investigate the extent and variety of the animal population and the extensiveness of the food supply. If the excursion is made during winter, pull loose pieces of bark from logs and trees to observe any insects that may be hibernating.
6. If a small land turtle has been added to the room aquarium, it may be possible to observe it burrow. At the beginning of winter place the turtle in a large receptacle and supply it with both earth and water. It should be kept where the temperature is lower than that of the schoolroom.
7. Since pages 32-33 show examples of mammals, birds, insects, reptiles, and frogs *(Amphibia)*, the pupils should review the common characteristics of each group of animals. They should classify the animal pictures they have collected on the basis of these groups. Instead of using the term *Amphibia* to classify this group of animals, the heading "frogs, toads, and salamanders" may be used.

Pages 34-35

Relation to the Unit: To present ways in which people can conserve wild life.

Concepts:

A. Some animals are unable to find food in winter when the ground is covered with snow.
B. Animal tracks have distinguishing characteristics that identify the animal.
C. Animal tracks reveal the winter haunts of animals and serve as a guide to man in the placement of food caches.

Procedure: These pages should be read as a picture-story. In Picture 1 the boy is putting grain in a self-feeder box and the girl is pointing to tracks in the snow. The food on the sled is for other animals. Pupils should attempt to guess which animal has made the tracks shown in the foreground.

Picture 2 shows that the children have followed the tracks for some distance and that the tracks were made by a squirrel.

In Picture 3 nuts have been left for the squirrel and the boy and the girl have discovered the tracks of another animal. The pupils should compare these tracks with those of the squirrel, and the distinguishing characteristics of the tracks should be discussed. Explain that animal tracks in snow are blurred but that certain distinguishing features can be seen.

Picture 4 shows the type of natural shelter that rabbits use in winter.

In Picture 5 carrots and cabbage have been left for the rabbit and another set of tracks is seen. The pupils should compare the tracks in the foreground with those of the squirrel and rabbit in the other pictures. The long mark (made by the mouse's tail) between the foot tracks should be pointed out as the outstanding, distinguishing feature of these tracks.

While discussing Picture 6, the pupils should identify the animal as the white-footed mouse

or deer mouse. They should notice that the tracks tell this story: The boy and girl followed the animal tracks to the stump. They left corn and pieces of apple for the mouse and then departed in a slightly different direction, as shown by the boy's foot that is going out of the picture.

In discussing the cornstalk shelter for pheasants in Picture 7, explain that many farmers build such winter shelters for game birds. The food that the boy has is probably wheat or oats.

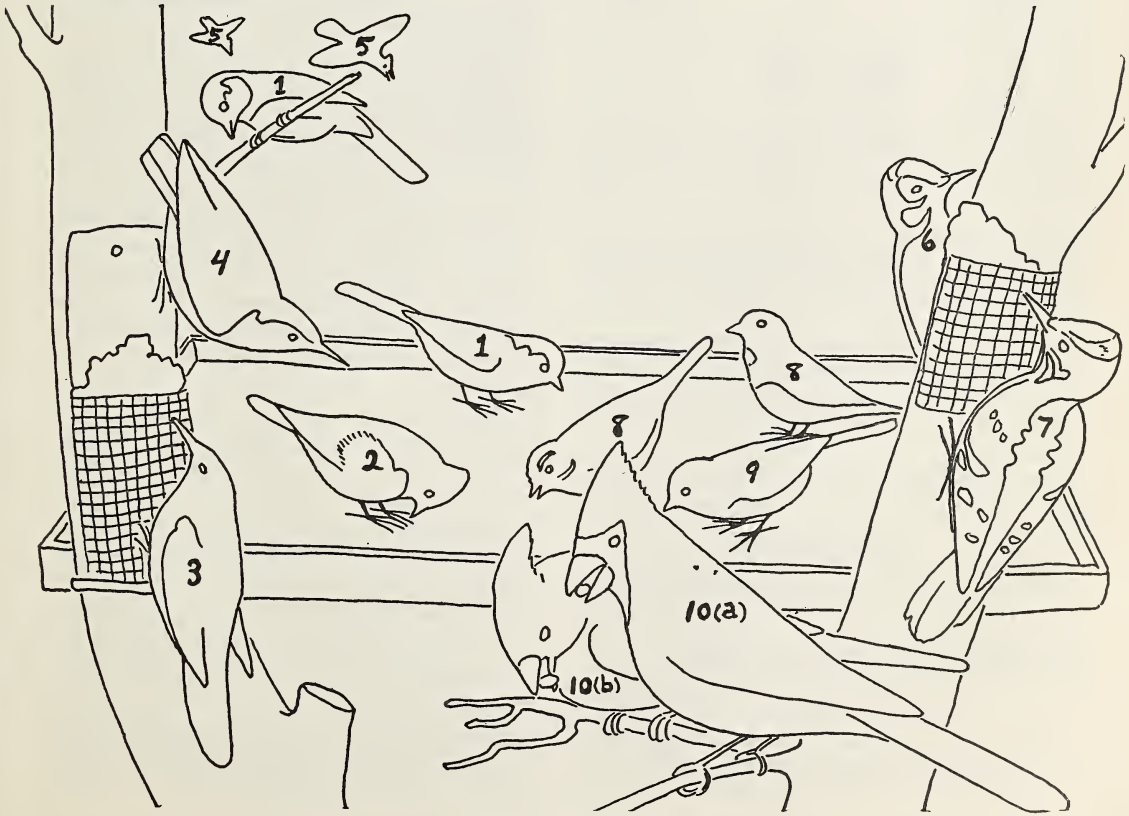
Picture 8 provides a satisfactory ending for the story by showing the boy and girl returning home with the empty sled and eating the apples they saved for themselves.

This story should impress the pupils with the fact that after a heavy snowstorm it is difficult for wild animals to obtain food, even though they are fitted to find it in winter. Twigs, weed seeds, bark, and food caches are often covered by deep snow. Consequently, the animals would starve to death if people did not feed them.

Extending and Enriching Activities:

1. Collect information concerning the different ways in which people can conserve wild life. Such an activity should not be confined to winter feeding but may include such matters as game laws for protection, national animal reserves, fish hatcheries, and lake and stream stocking.

2. Additional studies of animal tracks may be made. Illustrations of track patterns may be drawn and exhibited with pictures of the animals. Information on tracks and illustrations of them can be found in such books as *Wild Animals of North America,* National Geographic Society, pages 29, 34, 45, etc.; *Parade of the Animal Kingdom,* by Robert Hegner, pages 519, 520; and *Animal Tracks,* by George F. Mason. (See the Bibliography, pages 164-172.) If the lesson is presented in winter, a field trip may be made after a snowstorm.



Kind of Bird	Size	Food in Picture	Range in Canada
1. Black-capped chickadee	5¾ inches	Weed seeds and suet	Common in eastern Canada; less common in the Prairie Provinces; does not occur in some areas.
2. Tufted titmouse	6 "	Weed seeds	Southeastern Canada; not common in most parts of its range.
3. Brown creeper	5¾ "	Suet	Eastern Canada; range extends into Manitoba.
4. White-breasted nuthatch	6 "	Suet	Most parts of eastern Canada; less common in the Prairie Provinces.
5. Bluejay	11½ "	----------	Southern Canada, west to the Prairie Provinces.
6. Downy woodpecker	6½ "	Suet	Southern Canada as far west as Alberta.
7. Hairy woodpecker	9½ "	Suet	Southern Canada, west to the Prairie Provinces.
8. English sparrows	5¾ "	Weed seeds	Introduced from Europe, and now found in all settled areas of southern Canada.
9. Slate-colored junco	6 "	Weed seeds	Throughout Canada, extending as far north as the Arctic shores.
10. Cardinal a. Male b. Female	8¾ "	Sunflower seeds	Fairly common in a few parts of southern Ontario; rare in most other parts of southeastern Canada; not found in the Prairie Provinces.

Page 36

Relation to the Unit: To present a way in which man can protect birds and study their food habits; to promote appreciation of the aesthetic pleasure birds provide.

Information for the Teacher: The diagram and chart identify the birds and give information as to their range, typical size, and food.

Procedure: Have the pupils read the text and examine the first picture. The kind of books the boy and girl are using should be noted, and predictions should be made as to how the boy and girl will solve their problem.

In discussing the second picture, the pupils should identify the winter birds and notice how the homemade suet feeders are constructed.

The teacher should use the chart to verify or correct the pupils' guesses as to the kind of food each bird is eating.

Extending and Enriching Activities:

1. The pupils will undoubtedly wish to engage in a bird-feeding activity. If it is wintertime, plans can be made for feeding the birds. (See the Appendix, page 156.) The pupils should observe closely to see what foods are preferred by the different birds. If the page is read during the spring, it should be understood that birds will have little need for a feeding station, since there is an adequate, natural food supply available. However, other interesting activities can be engaged in. Birdhouses and baths can be planned and made. Plans could be started for a feeding station for next winter.
2. Posters on how to protect nesting birds from cats may be made for display in the community.
3. The teacher should encourage a summarizing activity when a unit has been completed. Such a procedure will not only summarize the ideas of the unit for the pupils but will also enable the teacher to determine the extent of the pupils' understanding of these major concepts of the unit:
   a. Animals must have food to live and grow.
   b. Animals find food in their environment.
   c. Animals are equipped structurally to obtain food.

   Charts and posters made during the progress of the unit may be grouped according to the ideas listed above.

UNIT 2: Land and Water

General Concepts

A. The land areas of the earth's surface vary in physical characteristics.

B. The water areas of the earth's surface vary in form and size.

C. Land and water areas are utilized in various ways.

(For a more detailed outline, see the Index to Concepts, page 95 of *How Do We Know?*)

Page 37

Relation to the Unit: To promote awareness and observation of the physical characteristics of the land and water areas in the environment; to provide the teacher with an opportunity to determine the extent of the pupils' experience relative to the main concepts of the unit.

Information for the Teacher: This unit, an elementary study of earth science, provides much geography readiness. For geography is the study of man's relationship to five spheres. First there is the *lithosphere,* or solid part of the earth, the continents, islands, mountains, plains, and valleys. Second is the *hydrosphere,* or water parts of the earth, the ocean, lakes, streams, water in the form of rain, in pipes, behind dams, etc. Third is the *atmosphere,* the air that surrounds the earth, without which no plant or animal can live, and which determines weather and climate. The fourth is the *biosphere,* the living part of the earth—the plants and animals, which furnish all of man's food, most of his clothing, and much of his shelter. Fifth is the *anthroposphere,* man himself, the tool user, the builder, the inventor, the organizer, and planner.

This unit, then, presents science understandings about the first two spheres—the land areas of the earth's surface and the water areas. In previous units of this primary science series many elementary science concepts necessary to the understanding of man's relationship to the other three spheres have been developed.

Procedure: Have the pupils turn to page 37 and read the title that tells what the next part of the book is about. Then ask, "Is there both land and water in the picture?"

The picture should then be discussed in detail. Ask such questions as: "Why do you think these people are here? Do you ever go on picnics? Why is this a good spot for a picnic?" Pupils should contribute such comments as: "It is a green, grassy, open place. There is nice, cool shade. There is a stream where the children can wade."

Note whether the pupils use the terms *brook, creek, run,* or *river,* in discussing the stream and present such words as they are used in the discussion. Endeavor to determine what ideas and experiences are associated with the names given to streams by asking: "Is there a stream near us? How wide is it? Does it sometimes go dry? What do you call it?" Further discussion of the picture may be stimulated by these questions: "Where do you think the boy found the frog? How deep do you think the water is? Why do you think so? Which way is the water running? What do you call the place where the water drops down to a lower place? (waterfall) Is the land perfectly flat?" Pupils should note that the ground appears to be uneven and slightly higher in the foreground than in the background. "Are there places like this near your home where you can go for picnics?"

During the discussion of picnic places, some or all of the following terms may be used in addition to those applied to streams: *hills, mountains, lakes, ponds.* Present the words and determine what ideas pupils associate with them by asking questions such as: "Can you climb to the top of the high places? Is there land all around the water?"

Some pupils may recognize the characteristics of a valley. If so, present the word at this time.

Pages 38-39

Relation to the Unit: To present graphically the fact that our environment is made up of various land and water forms; to develop concepts of land and water forms by comparison and contrast.

Concepts:

A. Bodies of water that flow across the surface of the earth are called "streams."

B. Bodies of water that are surrounded by land are called "lakes" and "ponds."

C. Large, flat areas of the earth's surface are called "plains."

Information for the Teacher: Most children at this age have not traveled extensively and usually are not aware of the distinguishing characteristics of the various land and water forms. Therefore, the concepts of the unit should be limited to those that can be developed through observation. No attempt should be made to discuss how the various land and water forms have come about. The pupils' progress should be considered satisfactory if they are able to identify the various forms presented pictorially in the unit and similar ones in their own environment.

Procedure: The pupils should read the first two lines of text and comment on the attractiveness of the three picnic places shown. Be sure they understand that the picture at the top starts on page 38 and continues across page 39 but that the picture at the bottom of each page is a separate scene.

A general survey of each picture may be made in answer to such questions as: "What season is it? What kind of day is it? Why do you think the people chose this spot as a picnic place? Do any of these pictures show how the country near us looks?"

As preparation for answering the first question on page 38, ask, "What do you call the stream of water that is running (or flowing) across the land in the top picture?" Pupils may use various terms, such as *river, creek,* or *run,* but they should be led to agree on *river* because of its apparent size. "Is there a river in our community? What is its name? Do you know how far it runs (or flows)?" During all discussions of streams, stress the fact that the water in all of them has a distinct movement in one direction and that the word *streaming* connotes *flowing.*

If the pupils are undecided as to whether the top picture shows hills or mountains, let this question stand by saying, "We may be able to decide after we have studied other pages in our book."

In answer to the first question on page 38, the pupils should observe the differences between the hilly land along the stream in the top picture, the sandy beach in the picture at the bottom of page 38, and the wide, flat land in which bodies of water are absent in the third picture.

To start discussion of the bottom picture on page 38, ask, "What differences in shape do you notice between this body of water and the stream above?" When the differences in shape have been noted, lead the pupils to comment that this body of water seems to be surrounded by land. Then ask, "What name do you think we should give this body of water?" Present the words *pond* and *lake.*

Direct attention to the third picture and lead the pupils to identify the place on which the children in the picture are standing as the platform of an observation tower. Such towers are fairly common and are placed at points where there are wide scenic views that might be of interest to people. Bring out the fact that stairs lead up to the platform. Then ask: "Do you think the children on the tower platform can see more land than the people on the ground? Have you ever been on a high place where you could look down on the land below? What could you see from the high place that you were unable to see when you were on the ground? What kind of land are the children in the picture looking at? Can they see much of this flat land? Yes, they can see it for several miles. This wide, flat land is called a 'plain.'" Write the word *plain* on the blackboard.

Guide the formulation of statements defining "stream," "lake," and "plain" similar to the wording in the Index to Concepts for Unit 2 on page 95 of *How Do We Know?* Write these statements on the board as they are agreed on by the group. Then proceed with the reading and discussion of the rest of the text.

As readiness for the concepts of Unit 3 ask, "In which of the three pictures does the land look the best for raising crops? Why?" Pupils should observe that the fertile plain is more suitable for cultivation than the steep hills or the sandy area shown in the other pictures.

Extending and Enriching Activities:

1. Start a bulletin-board display of "places we like to visit." Pupils may bring photographs of various scenic spots in their own community or in their travels—mountains, rivers, lakes, deserts, etc. These scenes

should be appropriately labeled, and attention should be focused upon the physical characteristics of the land.

2. Draw pictures or bring photographs of various popular picnic and resort areas in the local environment and compare these with the picnic areas shown on pages 38-39.
3. Have the children describe their favorite picnic spots and let the other members of the class attempt to identify them. Compare these descriptions with the areas pictured on pages 38-39.

Page 40

Relation to the Unit: To present graphically the fact that hills and mountains are raised parts of the earth's surface; to develop concepts by comparing like and unlike forms.

Concepts:

A. Hills and mountains are raised parts of the earth's surface.

B. Mountains are higher than hills.

Information for the Teacher: It should be noted that in order to avoid confusion, sheer, precipitous mountains are presented in contrast to rolling hills. If there are hills or mountains in the locality, the teacher should make the pupils aware that not all mountains are so steep and that not all hills are so rounded as those shown on this page.

Procedure: Present the title and read the text under the first picture. Have the pupils point out the hills. Then ask, "How are these hills different from the other parts of the land in the picture? Yes, they are higher. Hills are the raised part of the land."

In order to strengthen the concept of raised land surfaces as opposed to flat surfaces, say: "Do we have any hilly land in our neighborhood? Which is harder to do, to walk on flat land or to walk up a hill? Now turn back to pages 38 and 39. What would you call the land along the stream? Are these hills the same size as the hills on page 40?" Call attention to the fact that the water in both pictures is on a lower level than the hills.

Have the pupils point out the mountains in the second picture. Then ask, "How are mountains like the hills you see above?" (Both are raised parts of the earth's surface.) Ask the pupils to read and answer the question at the bottom of the page.

Although a phrase such as *timber line* need not be used, the children's attention should be directed to the gradual decrease in plant growth as the height of the mountains increases and to the consequent decrease in animal population. Call attention to the sheep in the valley, to the deer, and to the mountain goat on the higher levels.

Pupils should note that the rolling hills are under cultivation, while the mountains are not. The fact that the hills have sufficient soil to support vegetation, while the mountains do not, may be mentioned by some pupils. This fact should be utilized to promote readiness for a major concept of the Plant Unit—that plants need soil.

To strengthen concepts of differences in size between hills and mountains, ask: "Do you think it is harder to climb mountains than hills? Why do you think so?" Draw attention to the climbing equipment used by the men.

To promote appreciation of the scenic features of hills and mountains, ask why the two men have climbed to the mountaintop. Recall page 39 and the discussion as to why the children in the picture climbed the tower.

The term *valley* should develop naturally in the discussion. Have the children look at the bottom picture and point out the lowest part of the land. Then ask, "What could we call this low ground? Yes, it is a valley. What does the valley have running through it? Now look at the top picture again. Can you find a valley and a stream in it?"

Extending and Enriching Activities:

1. Pictures of mountainous and hilly areas, collected by pupils, should be compared with those shown on page 40 of *How Do We Know?* Note carefully the vegetation along mountain streams and the apparent size and extent of the ranges of mountains and hills. The pupils should formulate descriptive captions for the pictures.
2. To promote elementary understanding of our natural resources, call attention to the fact that some land areas are not adapted to farming but that valuable materials such as stone, minerals, metals, oil, and coal are taken from many of them. (See the Bibliography for reference material.)

Page 41

Relation to the Unit: To present graphically various physical characteristics of the low areas of the earth's surface; to develop concepts by comparison of like forms.

Concepts:

A. Valleys are low places between hills and mountains.

B. Valleys vary in size and other physical characteristics.

C. Many valleys have streams.

Procedure: The discussion of valleys in the preceding lesson plan should have sufficiently prepared the pupils who were otherwise unfamiliar with valleys to recognize the one on page 41. After the pupils have read the title, they should examine the picture and point out the valley. Then have them read the text. In answering the last question, differences in size and shape should be commented on. Differences in vegetation also should be noted. The pupils may then compare the mountain valley and the one on page 41 with the low areas in the picture at the top of page 40 in order to stress the ways in which valleys vary.

Then ask, "What do these three valleys have running through them? Yes, these three have streams, as many but not all valleys have. How are all valleys alike?" (They are always lower than the surrounding land.) Point out that some valleys are so wide that the hills or mountains on each side cannot be seen unless one travels several hundred miles. Picture geographies contain pictorial relief maps that are helpful in developing these concepts.

Call attention to the bluffs on page 41 and explain the meaning of the term. Compare the steep bluffs with the hills and mountains on page 40.

Extending and Enriching Activities:

1. Compare the physical appearance and the utilization of the valleys shown on pages 40 and 41 with any in the local environment. Determine which pictures show valleys most like those with which the pupils may be familiar.
2. Examine the pictures of hills and mountains collected for Activity 1, page 38, and find the valleys. Discuss the sizes of the valleys and the uses made of them by man. Let the children express opinions as to which ones they would choose for their homes.

Pages 42-43

Relation to the Unit: To present graphically the various physical aspects of extensive flat areas of land; to develop concepts by comparison of like forms.

Concepts:

A. Plains are wide, flat areas of land.

B. Plains vary in size and in the uses which man makes of them.

C. Plains vary in character according to geographical regions.

Information for the Teacher: The picture on page 42 is typical of the wide, flat farming plains of the Midwest. The top picture on page 43 is typical of the West and the Southwest, and the bottom one, of a desert.

The desert picture shows various species of cacti in the blossoming season, which is just after the early spring rains. The large-branched species is saguaro; the red-flowered plants are ocotillos; the white-blossomed plants are chollas; the cactus in the right foreground is the prickly pear; and the small bushes are sage.

Procedure: Have the pupils read the title and the text on page 42. Then refer them to their own definition of a plain, which they worked out in connection with the study of page 39. Have them enumerate the points of resemblance between the land in the picture on page 42 and the land at the bottom of page 39.

Call attention to the first picture on page 43. After the pupils have read the text, they should compare this plain with that on page 42, observing the differences in kinds of vegetation and in the number of homes and roads.

Since no water is shown in the first two plains, explain that lakes and streams occur in such areas. Explain also that dry areas such as that in the last picture are caused by scarcity of rainfall. Then ask, "Is the third plain as thickly covered with growing plants as the other two plains?" Suggest to the pupils that the text may tell why plants do not grow so thickly on this third plain. Determine whether anyone knows what extensive, dry plains are

called. Present the word *desert* and have the text at the bottom of the page read aloud.

Then say, "Describe the ground or soil in your lawns and gardens when there has been no rain for several weeks. How do the grass and other plants look?" Tell the pupils that certain kinds of plants can store water in their leaves and stems and thus can live through periods of drought. Explain that deserts are usually called "waste land," and ask the children to comment on the reason for this name.

If members of the class are interested in knowing the names of the desert plants shown in the picture, identify each plant. (See Information for the Teacher in this lesson plan.)

Extending and Enriching Activities:

1. The pupils may be interested in knowing why cattle- or sheep-raising is typical of western plains. The discussion may cover such topics as the amount of grazing land required, reasons why less fertile areas are often suitable, reasons why such highly fertile areas as that shown on page 42 are seldom used for grazing, etc.
2. Add pictures of desert areas to the picture collection and label them with descriptive captions. These pictures should include scenes in various desert areas and in seasons other than early spring. The plants in the various pictures should be compared, and any animals shown should be identified.

Pages 44-45

Relation to the Unit: To present graphically typical bodies of water surrounded by land; to develop concepts by comparison of like forms; to develop the ability to make inferences from observed facts.

Concepts:

A. Lakes vary in circumference and depth.

B. Very small lakes are called "ponds."

C. Very shallow lakes or ponds are called "swamps."

Information for the Teacher: The first swamp shown is in the southern United States. The animals are a wild boar, alligator, and crane.

Procedure: The method of presentation will depend largely on the environmental background of the pupils. It usually will be found advisable to preface the study of the pictures with a discussion of water forms that are familiar. The children should name the bodies of water they have seen and tell where they have seen them. Bring out that while all ponds and lakes are surrounded by land, some lakes are so large that we can see only a small portion of the surrounding land.

After the books have been opened to page 44, have the title read. Direct attention to the first picture and its label. Then ask, "How deep do you think the pond is? Why do you think so?" The pupils should look at the other two pictures and read the labels. In answering the questions on the page they should point out the various features in the pictures that indicate the shallowness of the swamps—the vegetation, wading animals, and muskrat lodges. Note that the plants in the southern swamp differ from those in the typical Canadian swamp.

The pupils should reëxamine Unit 1 of *How Do We Know?* to determine how many of the animals shown on page 44 were previously presented in the book. They should also determine which of the water animals shown in Unit 1 might conceivably live in the various environments shown on pages 44 and 45.

Use the same procedure in studying page 45, eliciting in answer to the questions that the lake at the bottom of the page is much larger than the one at the top and that the larger lake is big enough and deep enough to be used for transportation of goods and people from one place to another. Explain that the purpose of the dock, or pier, is to furnish facilities for loading and unloading ships. Lead the children to use the terms *beach* and *shore* and to understand their meanings.

Extending and Enriching Activities:

1. Visit a pond, swamp, or lake in the locality if possible, and compare it with the pictures in *How Do We Know?* as to size, depth, utilization, etc. The use of natural bodies of water as a source of water supply also may be mentioned.
2. Collect pictures of different geographical regions—the Far North, Eastern Canada, the Prairies, etc. These pictures should show bodies of water and the plants and animals typical of the region.
3. Pupils who live near an ocean or who have visited one should tell the others about the salt water, the tides, the waves, etc.

4. If the locality is near one of the Great Lakes or an ocean, an interesting trip to the docks can be arranged to observe the loading of ships. If such a trip is not feasible, have the pupils refer to pages 38-39 of *All Around Us,* where a scene typical of an ocean harbor is shown, and discuss the activities portrayed.

Page 46

Relation to the Unit: To present graphically various typical streams; to clarify the meaning of the terms *river, creek, brook;* to develop concepts by comparing like forms.

Concepts:

A. The generic term *stream* can be applied to any body of water that flows across the earth's surface.

B. Various terms are used to designate streams.

C. Streams vary in length, width, and depth.

Procedure: Present the title and direct the pupils to examine each picture and decide whether it shows water that seems to be moving, or flowing, from one place to another. Explain that the word *stream* applies to all bodies of water that flow across the earth's surface. Then ask: "Is the stream in the top picture as wide as the one in the bottom picture? Is it as deep? What is this stream called? What is the second stream called?"

After the labels have been read, explain that the terms *brook* and *creek* both mean a small stream and that some people use both words while others use the word *brook* but do not use *creek.* Since the children have already associated the word *wide* with the last stream, they should have had no difficulty in reading the label on the bottom picture.

In answering the first question the pupils should note differences such as (1) the low, grassy banks of the creek and the steep, rocky walls of the mountain brook; (2) the greater width and apparent depth of the river; and (3) the sharper slope of the brook.

In answer to the second question, statements similar to the following should be formulated by the pupils: "All these bodies of water are streams." "All of them have banks, and the water in all of them is flowing from one place to another." Evidences of movement such as the current and the falls should be discussed. Since no adequate concept of length can be given by these pictures, pupils should draw on their actual knowledge in discussing the possible length of streams such as those pictured on page 46.

Extending and Enriching Activities:

1. Visit a stream in the neighborhood. Put leaves, pieces of wood, toy boats, etc., in the stream and note whether the water carries them along. Determine whether the water in the stream moves in only one general direction. This activity forms an excellent introduction to the concepts to be developed on pages 47 and 48.
2. Determine whether moving water has force. This can be done by putting the hand into a stream and feeling the pressure, by constructing a small earthen dam and noting how quickly the water destroys it, by constructing a small water wheel and observing that the flowing water exerts enough pressure on the wheel to turn it. If the pupils live near a stream that is used for water power in operating machinery, they should visit it to see how the force of water turns wheels, thus building readiness for the concepts presented in Unit 4 of *How Do We Know?*
3. Obtain maps of the township or county from a surveyor's office, or from the office of the township or county clerk, and guide the children in tracing the streams shown. Explain the scale of miles to the pupils and compute the approximate length of the local streams. Compare the length of the small streams with that of the larger rivers. In this connection use elementary geography books from your school or community library. (See the Bibliography.)

Page 47

Relation to the Unit: To promote ability to form an inference based on observations.

Concepts:

A. Small streams such as brooks and creeks run together and form rivers.

B. Rivers run into larger bodies of water.

Information for the Teacher: Since it is natural for a child to associate the idea of "highness" with the top of a picture, the mouth of the river has been placed at the top in order to promote the wrong guess and to focus attention on the indications of elevation in the picture. The perceptions developed on this page and on pages 49, 50-51, and 52 promote readiness for map reading at later levels.

Procedure: Before they read the text, have the pupils identify all the land and water forms which they recognize in the picture. Bring out the fact that the lake is lower than the hills. Then the text should be read and the picture carefully studied before opinions are advanced in answer to each question.

Opinions should be discussed and evaluated, but no attempt should be made by the teacher to make the entire class agree on a given answer. Some pupils will infer that water runs out of the lake and into the hills, and others will infer the opposite. Ask them why they think as they do, and tell them that since they do not agree, it will be necessary to find out which opinion is the correct one. Suggest that some pupils may wish to change their answers after they have obtained more information through the experimental procedures shown on the next page.

Page 48

Relation to the Unit: To present experimentation as a method of determining the validity of inferences based on insufficient evidence.

Concepts:

A. Water flows toward the lowest point of outlet.

B. The higher the slope, the faster the water flows.

Information for the Teacher: The meaning of the word *experiment* and the experimental method of obtaining evidence to solve a problem were presented in the preceding book of this series. (See the lesson plan for page 73 of *All Around Us.*) If the pupils have not used that book, the teacher should explain that an experiment is a test, or trial, that is made in order to find out something.

Procedure: Before the study of the page is begun, the teacher should say: "We have a problem to solve. Some of you think the streams on page 47 run into the lake, and some of you think that the streams run out of the lake. Page 48 tells how to do some experiments that will show us who is right." Present the word *experiment* and direct the pupils to study each picture carefully as they read the text accompanying it.

Before duplicating the pictured experiments, the pupils should decide (1) what the problem is, (2) what the plan of procedure is, (3) what equipment they will need, and (4) what they expect to determine from the experiment.

Great care should be taken to develop, in addition to the lesson concepts, the correct procedures in experimentation. The pupils should understand that they have a question to which they are trying to find a definite and accurate answer. In order to do so, they must (1) assemble the materials needed, (2) follow a planned procedure with the materials, (3) observe the results, and (4) from their observations draw a conclusion that answers the question.

When the second experiment has been performed by the pupils, the teacher should ask, "In what way is the tipped pan like the picture on page 47?" (The slope of the pan corresponds to the slope of the land—both have a high part and a low part.)

Before the pupils duplicate the last experiment, be sure they notice that the reverse end of the pan is lowered. Have them point out the lowest corner. Then ask: "Which corner was lowest in the second picture? Why isn't the water running out of the same corner as before? How do these experiments solve our problem in deciding which way the water on page 47 runs? What did the last experiment show us?" (Water runs faster as the slope gets steeper.) The pupils must do the last experiment several times, as the text suggests, in order to come to this conclusion.

Page 49

Relation to the Unit: To provide an opportunity for the application of principles determined experimentally; to promote the ability to use one page as a reference in the interpretation of another page.

Information for the Teacher: This representation of land elevation closely resembles a relief map and thus provides an opportunity for enriching the understanding of the term *map,* which was first introduced in Activity 3 of the lesson plan for page 46.

Procedure: Call attention to the fact that the highest and lowest parts of the land in this picture are the reverse of page 47. The pupils should read the text and answer the questions, basing their answers upon evidence obtained in their experimental activities. In the event of disagreement the experiments should be repeated. The children should now be made aware that they are no longer guessing the answers but are applying experimentally determined facts.

Extending and Enriching Activities:

1. Model some hills—both low rolling hills and high ones—on the sand table to extend understanding of a relief map.
2. Pour water from a vessel with a deep spout over the modeled hills to observe the direction of the running water. Evidence of the force of water may be observed as the water carries away sand and makes channels.
3. Picture geographies should be used to extend concepts of land forms and the formation of a river system.

Pages 50-51

Relation to the Unit: To give the teacher an opportunity to determine the extent of the pupils' understanding of the main concepts of the unit; to promote ability to interpret new situations in terms of familiar ones.

Procedure: The pupils should understand that the two pictures begin on page 50 and extend across page 51. They should examine the pictures thoroughly and discuss them in detail as each section of text is read. The teacher should note the responses carefully in order to determine any gaps in the pupils' understanding.

The sand dunes along the large lake in the top picture should be compared with the bare mountains in the lower picture and with the fertile hills on pages 40 and 47.

Three valleys in the lower picture can be identified by the pupils as follows: one is a low valley between the mountains on the extreme left; one is a high valley in the right foreground; the third is a narrow, rocky valley between the other two. The three valleys should be compared as to their apparent width. Bring out the fact, which most pupils have discovered from actual experience, that distances between points are much greater than they appear to the eye. Other physical characteristics of the valleys may be compared. For example: the valley extending up into the mountains at the left has grass and timber; the one in the right foreground has cultivated crops; the third valley is barren and stony.

The fact that all the comparatively level areas in both pictures might be called "plains" as well as "valleys" should be discussed.

Pupils should note in the lower picture that the mountain lake is fed by melting snow on the mountaintops and that the streams begin as outlets from the lake.

As an application of evidence gained from the experiments described on page 48 of *How Do We Know?* ask the pupils to decide which streams on the steep slopes run fastest and have them state reasons for their decisions. Since the land elevation, even in the valleys, is more apparent in the lower picture than in the upper one, the pupils will draw the obvious conclusion that the large streams in the lower picture flow faster than the large stream in the upper picture.

If the class has discussed or visited a dam built for water power, they should notice the dam and the factory in the left foreground of the lower picture on page 50. The shallow lake or pond in the right foreground of the upper picture on page 51 may be compared with the swamps on page 44 of *How Do We Know?*

When the pupils have selected the picture, or the parts of a picture, that most closely resembles the land near their home, they should decide what physical characteristics in the picture should be changed to conform to those typical of their own environment. Thus, they might point out that there should be no swamp or that the city should be larger, etc. When these differences have been discussed, pictures may be painted or drawn, depicting the distinguishing physical features of the local area.

Extending and Enriching Activities:

1. Pages 49 and 50-51 give the teacher an opportunity to promote ability to interpret maps. Depending upon the maturity of the pupils, the maps may range from a simple relief representation of the immediate environs to a scaled road map. The concept that the top of the map is north, the bottom, south, the right side, east, and the left, west should be developed. On a large relief map the children should compare the representations of high land and indicate which they think are hills and which are mountains. Trace river systems from their sources in the high parts of the land to their mouths. Identify the stream nearest the area in which the pupils live. Locate the plains. The fact that plains are also valleys should be stressed, and the high land on both sides of the valleys should be pointed out. The teacher should use a scale of miles and inform the pupils as to the extent of the mountain ranges, the large river systems, the larger valleys, and the plains. She should also tell the names of the mountains, rivers, etc. Pictorial maps should be used in connection with this activity.
2. If possible, make an excursion to a small stream and build a temporary dam across it. Note the strength of the water pushing against the dam and the force of the falling water spilling over the top of the dam. This activity promotes understanding of the fact that water seeks its own level as it flows across the earth's surface.

Page 52

Relation to the Unit: To suggest a summarizing activity that applies the concepts of the unit.

Procedure: When the children have read the text, studied the pictures, and answered the question, they should be encouraged to make a similar sand-table representation of their own neighborhood. The extent of the representation will depend on the size of the sand table available.

The pupils should decide whether they wish to show their town, the farm of one of their classmates, or the nearest industrial or shipping area. Then, if possible, the locality decided on should be visited so that the pupils can observe the general topography of the land and get the information needed for the construction activity. In order to avoid hit-or-miss observation they should determine what information will be needed before they make their trip.

Extending and Enriching Activities:

1. Through excursions and the contributions of pupils who are familiar with farming areas, the term *soil* should be made meaningful. It should be brought out that some soils (fertile) produce luxuriant vegetation, while other soils (sandy or stony) support only sparse vegetation. While they are on excursions, the children should obtain samples of different kinds of soil, from coarse gravel to rich loam. These samples can be used for the experiments in the Plant Unit.
2. From the pictures collected during the progress of the study of the unit choose those scenes which are typical of the land and water forms in the local area. Make a large scrapbook entitled "Our Land and Water." Descriptive captions such as "Green River in Early Spring," "Skating on Miller's Pond," etc., should identify each picture.

UNIT 3: Plants

General Concepts

A. Water, sunlight, and certain materials found in soil are necessary for plant development.

B. Green plants manufacture their food.

C. Plants have definite parts with distinguishing physical characteristics.

D. Plant structures have definite functions in food-making.

E. Plants have definite parts by which they perpetuate themselves.

F. Plants have enemies that can destroy them or retard their growth.

G. Plants are protected by man so that he can derive food and pleasure from them.

(For a more detailed outline, see the Index to Concepts, pages 95-96 of *How Do We Know?*)

Page 53

Relation to the Unit: To stimulate interest in plants as living things; to present an opportunity to discuss and promote appreciation of the aesthetic value of plants.

Procedure: Have the pupils look at the page and read the title. Then ask: "What makes this house so pretty? Would you want to live here if all the flowers and the trees were taken away? Do you know the names of any of the plants in this picture? Are there any flowers like these in your yard or garden? Do you think that the people who live in this house take care of their plants?

"Have you ever seen plants growing in a pool? Do you think they have roots? How do you suppose they live in the water? Look at page 67 and you will find out how a water lily can float on the water and still have its roots in the soil." If the pupils have had experience with pools, they may tell about other types of water plants and how they are equipped to get their leaves and flowers, if any, into the air above the water's surface. If there is an aquarium in the classroom or in some other schoolroom, the children should examine the aquatic plants and see how their roots and stems differ from those of common land plants. (See the Appendix, pages 154-155, for suggestions on stocking an aquarium.)

Allow the pupils to glance through the unit and have them read the titles in order to get a preview of the main topics. Discuss briefly the titles and pictures that excite the most interest, but do not encourage detailed study of any one page at this time.

While scanning the unit, the pupils will see that experiments are being performed with plants. The title of each experiment page may be briefly discussed in order to promote interest in the experimental method of obtaining facts concerning plants. Tomato, bean, and other garden seeds should be planted at this time so that seedlings will be started by the time pages 56-63 are presented. These seedlings can be used later to duplicate various experiments described in *How Do We Know?* (See the Appendix, page 158, for planting directions.)

Plant some tomatoes very thickly in one or two containers in order that the pupils may observe over a period of time how crowding affects the growth of plants.

Pages 54-55

Relation to the Unit: To present the main theme of the unit; to present a practical problem which stimulates interest in plants and provides an opportunity to apply experimental evidence regarding requirements for their growth.

Concept:

Plants need favorable growing conditions.

Information for the Teacher: Pages 54-55 will be referred to frequently as the experimental work of the unit progresses, since the major purpose is to provide an opportunity to apply the conclusions drawn from the experiments. Consequently, when these pages are presented, it should be suggested to the pupils that subsequent pages will help them decide which garden plot is best suited for plants.

Procedure: The pupils should read the text, examine each picture, and note the features described in the text. The teacher should be sure they understand that Pictures 1 and 3 begin on page 54 and extend across part of page 55.

The meaning of "good" or "rich" soil will be developed gradually through discussions of succeeding pages. It is sufficient for the time being if the term *soil* means soft, crumbly dirt as opposed to stones and coarse gravel.

Since pictures cannot adequately portray the texture of black soil or the extent to which ground is stony, the teacher should bring out that black soil is soft and crumbly. She should then ask, "Do you think that it is easier for tender garden plants to come up through loose, crumbly soil than through gravel and stony ground?"

Discuss each plot as to the following characteristics: (1) soil and light *vs.* soil and shade, (2) stony ground and light *vs.* stony ground and shade.

When the text has been read and the pictures have been studied and discussed, the characteristics of each garden plot may be listed on the blackboard for future easy reference. Thus, the pupils might make a list similar to the following:

Plot 1	Plot 2
sunlight	much shade
no buildings nearby	buildings on two sides
no trees	evergreens and big trees
black soil	black soil
no stones	no stones

The teacher should explain that since the children in the story were unable to decide which was the best plot for the school garden, they had to do some investigating to help them decide. The pupils may indicate the plot they consider best, stating reasons for their choice, but they should be told that experiments on subsequent pages may justify or change their opinions.

Extending and Enriching Activity:

If this lesson is presented at an opportune time, the pupils should be encouraged to plan a garden either at home or at school. In this event, the garden-making activities can be dovetailed with the successive lessons. Various available plots should be inspected, and the conditions of the soil and light should be listed for reference. Postpone final decisions as to which plot is most suitable for a garden until evidence has been obtained from the experiments set up on pages 56-59 in *How Do We Know?* The school gardens should be planted according to the plan on page 65. Reference books such as *Peter and Penny Plant a Garden,* by Gertrude and Frances Dubois (see the Bibliography), should also be used.

Pages 56-57

Relation to the Unit: To review the stages of plant growth as presented in *All Around Us;* to provide an opportunity for determining experimentally various requirements for plant growth.

Concept:

Plants that have sunlight and water but are deprived of soil do not complete the life cycle.

Information for the Teacher: Through experiments introduced from pages 56 to 63 in *How Do We Know?* the pupil gradually learns that plants manufacture their own food and that sunlight, water, and certain materials in the soil are important in the food-making process. Since experiments with plants usually involve several weeks, these pages have been planned so that pupils may perceive beforehand the results of the experiments by studying the pictures. Thus, they will have the expected results in mind for checking their own experiments in growing plants from seed.

Lima beans are used for the experiment on pages 56-57 because they are so large that the embryo plant can be seen easily. The stones in the jar support the plant in the absence of soil. Since seeds will rot if they are covered with water for several days, the stones also serve to keep the bean from being submerged. Glass jars are used in order to permit a good view of the root growth.

The experiments conducted during the study of page 73 of *All Around Us* demonstrated the fact that seeds will not germinate without water. However, if pupils have not had the preceding books of this series or any other science work to develop this concept, obtain a copy of *All Around Us* and have the class perform the experiment on page 73. Such an

activity will promote understandings that will prepare the children for the concepts of the Plant Unit in *How Do We Know?*

Pupils should duplicate the experiment on pages 56-57 of *How Do We Know?* but several seeds should be used here and in all succeeding experiments with plants. This will insure success with at least one plant in case something unpredictable happens to prevent the development of the others.

Although seeds have certain temperature requirements for germination and most plants thrive only in definite temperature ranges, no issue is made of this because the concepts are too involved to be understood at this level. The teacher should handle this matter through casual reference, such as: "Notice that the children put their plants on the window sill where they would get light and heat" or "When we plant our bean seeds, let's be sure to put them in a warm place so that they will sprout quickly." (Most of the seeds that will be used in the plant experiments require a night temperature of 50°-60°.)

Procedure: The pupils should read the title on page 56, which states the problem to be solved. They should relate this problem to the importance of soil as brought out on pages 54-55. Direct them to examine each picture as they read the text and note the changes in the growth of the plants. The pupils may observe that in the early stages of growth the soilless plant seems to thrive better.

Be sure the pupils notice in Pictures 5 and 6 that flowers and bean pods are on the plant growing in soil, while no flowers or pods have been produced by the plant that has no soil. To prevent the pupils from inferring that no plant will bloom in water, the teacher should point out that flowering bulbs can bloom in water and that the absence of flowers on the soilless bean plant is significant only because of its relation to fruit- or seed-bearing.

The study of these pages and experimental evidence should lead to the conclusion that soil is important to a bean plant because the soilless plant does not bear seeds and thus does not complete its life cycle.

Call attention to the differences between the cotyledons and the true leaves in Pictures 3 and 4 and have the children note that the cotyledons (the two parts of a seed containing the embryo and food) eventually shriveled and fell from the plants. The cotyledons of some plants function as leaves, helping to make food, but this fact need not be presented at this point. Tell the pupils that these first leaves are often called "seed leaves," because they actually exist in the seed. They contain food and nourish the young seedling until it develops true leaves. Further discussion of cotyledons should be postponed until pages 60-61 are studied.

When the text has been read and the questions have been discussed and answered, the lesson concepts may be clinched by discussing questions similar to the following: "Do plants need soil in order to live and grow? Is soil important only because it helps support the growing plant?" Point out the fact that the water-grown plant was supported by stones. Lead the pupils to conclude that since the plant grown in stones did not develop as the one in soil did, the stones failed to provide something important to plant growth which soil contains.

Then say: "The children in the story on pages 54-55 learned something from their experiment that helped them decide which of the four plots would make a good garden. What did they learn?" When the pupils have answered this question, have them turn back to those pages and decide which garden plots should be eliminated as possible choices on the basis of the study of pages 56-57. Thus, they should decide to eliminate Plots 3 and 4 because of the stony ground, which obviously would not nourish plants so well as the plots without stones. (See Activity 1 of this lesson plan for development of the concept that the kind of soil makes a difference in plant growth.) If they suggest eliminating Plots 2 and 3 on the basis of shade, point out that the children in the story have not yet definitely determined whether or not their garden will need sunlight and that they probably will obtain information concerning this question through experimentation.

Duplication of the experiment described on pages 56-57 will demonstrate the differences between plants grown in soil and those grown without soil. (See the Appendix, page 158, for detailed directions concerning the preparation of soil.) The containers of soil should be placed on pans or saucers to catch the excess water. Keep several bean seeds (both with and with-

out soil) dry all during the experiment to see whether or not they will germinate. Put two or three Lima beans in small jars and keep them covered with water to see whether they will grow or rot.

When the plants have reached the stage shown in Picture 4, they should be placed where they will receive full sunlight. They might be placed outside on a window sill or be moved to any other place where they can get full sunlight for a part of the day, but they must be protected from cold if the outside temperature is unfavorable. The pupils should note and keep a record of the experiment as follows:

1. The height of the plants at the end of each week
2. The sizes of the leaves and stems at the end of each week
3. The date on which flowers appear
4. The date on which pods begin to form
5. The condition of the plants without soil at the time pods appear on the other plants

As they watch the progress of their own experiment, the children should compare their plants with the pictures in the book and keep a record of the dates on which the living plants attain stages of growth comparable to those shown in the pictures.

Before the study of pages 56-57 is concluded, the teacher should be sure the pupils understand fully that a bean plant will germinate, grow, and live for a long period in water but that it will not produce flowers and seeds.

Extending and Enriching Activities:

1. The soil experiment may be further extended by using other types of growing mediums. Sand, black loam, clay, gravel, sawdust, and cinders may be used, and the results compared, but all the plants should have sunlight and water.
2. If provisions can be made for temperature regulation, experiments to demonstrate that temperature affects germination and the rate of plant growth may be set up as follows:

   Plant soaked beans in three boxes of sand, sawdust, or loam.

   Place one box where the temperature is about 70°. Place another box in a cool basement where the temperature is below 70° and the third where the temperature is 85° or above.

   All the seeds should have the same amount of water, and they should have identical light conditions. For about five days, keep a record of observations made each morning and late afternoon. From these records draw conclusions as to what temperature seems best for germinating beans.

   These experiments may be repeated with various other kinds of seeds, to demonstrate that each kind has a certain temperature at which it germinates best.
3. Chemical gardening is usually fascinating to children of this age level, and it provides a fine opportunity to demonstrate that plants need certain materials for making food. Several companies market chemical gardening sets for amateur gardeners. One such set may be ordered through the publishers of the magazine *Children's Activities*. The State Agricultural Department can provide a chemical formula for soilless gardening. However, it is advisable, where possible, to obtain a chemical gardening set already prepared for amateurs. It must be kept in mind that chemicals are not a substitute for light and that the experiment is doomed to failure unless the seedlings are provided with adequate sunlight.

Pages 58-59

Relation to the Unit: To demonstrate that plants need sunlight in order to grow; to provide further experience with the techniques of experimentation; to review the stages of plant growth.

Concept:

Green plants do not stay green if they are deprived of sunlight.

Information for the Teacher: It may be well to delay the presentation of these pages until the tomato seeds that were planted earlier (see the lesson plan for page 53) have produced seedlings. Then the pupils' duplication of the light experiment can coincide with the study of these pages in the book.

Although the cotyledons of bean plants retain the form of the seed until they drop off, those of tomato plants function as leaves in the early stages of growth. They drop off before the plant reaches maturity.

Procedure: The pupils should read the title, which states the problem to be solved. Then they should study each picture, read the text, and answer the questions.

After the study of the last picture on page 59 and the accompanying text, ask the pupils what they think will happen when the tomato plants are set out in a garden. Those who are familiar with the raising of tomatoes should describe the yellow blossoms, the small green tomatoes which form, and the growth and eventual ripening of the fruit. Compare the blossom and fruit of the tomato plant with the bean blossom and pod formation on page 57.

The tomato seedlings on these pages should be compared with the bean seedlings on pages 56-57, and the differences in leaf structure, arrangement, etc., should be noted.

In response to the direction at the bottom of page 59, the children should select Plot 1 as the most desirable one for the school vegetable garden. If they have listed the characteristics of each plot, as suggested in the lesson plan for pages 54-55, they should check them and determine why Plot 1 is the best garden spot.

The light experiment should be duplicated by the pupils in order to demonstrate with real plants the effect of depriving plants of sunlight. For this activity use some well-developed tomato seedlings that have been grown in the room. The experiment should be performed by several children, each one using two plants. Various ways of excluding light may be employed. A chart should be kept to record the following data:

1. The size and color of the plants at the beginning of the experiment
2. The amount of water given the two plants
3. The number of days before the plant that has been deprived of sunlight begins to lose color
4. The appearance of the plant that has had sunlight at the time the one without it is apparently dead

Extending and Enriching Activities:

1. If the pupils are planning to make gardens either at school or at home, they should select their plots on the basis of the knowledge gained from pages 54-59. The plots selected should be compared with Plot 1 on page 54 as to conditions favorable to plant growth. In case a gardening activity is impossible, potted plants and window-box plantings may be used for plant studies. (See the Appendix, page 158, and books such as *Play with Plants,* by Millicent E. Selsam.)
2. If the tomato-growing experiment takes place about two or three months before the end of the school year, the pupils may have an opportunity to observe in their own gardens the blossoming of the plants and the formation of fruit as the plants mature.
3. All the growth experiments performed by the pupils should be inspected daily. Any noticeable changes in the plants should be recorded on charts. (See the opposite column for data to be recorded.)

Pages 60-61

Relation to the Unit: To present the fact that plants make their own food; to demonstrate that green plants need moisture and sunlight in order to manufacture food; to promote ability to interpret diagrams and to make inferences; to provide opportunity to observe effects that follow certain conditions.

Concepts:

A. A seed contains the embryo of the new plant and food for its initial growth.
B. Water and sunlight help make and keep plants green, thus aiding in food-making.
C. Leaves and stems are the parts of plants in which food is made.

Information for the Teacher: Before the lesson is presented, the pupils should put Lima bean seeds in water, as directed on page 60, and let them soak for about sixteen hours.

Procedure: As they study the text and pictures on page 60, the children should examine the beans they have put in water and observe that the water has softened the seeds, making it easy to split them open for examination. A magnifying glass will be helpful in examining the embryo plants in the seeds.

The teacher should be sure that the labels in the second picture on page 60 are read correctly. The pupils should examine the cotyledons, or seed leaves, in the third picture and observe that the cotyledons correspond to the two halves of the bean seed shown in the second picture. Bring out that the concave appearance indicates shrinkage resulting from loss of food from the seed.

After the study of the last picture on page 60, one or two of the live bean plants growing in the room should be lifted from the soil. Compare the root and leaf growth of the pictured plants on pages 60-61 with that of the real plants, making sure that cotyledons are not confused with true leaves.

While the pupils are examining the first picture on page 61 and identifying the parts of the plant, see that they read the labels correctly. Before proceeding with the next picture, determine whether or not the inference that a plant's food is manufactured in the leaves has been made because pupils have recognized the relationship of these facts: (1) Food is made in the green parts of a plant; and (2) almost all the green coloring is in the leaves.

From evidence obtained by duplicating the light experiment on pages 58-59 and from the study of the second picture and the accompanying text on page 61, the children should infer that sunlight helps a plant make food because it makes and keeps the plant green. The teacher should check the pupils' understanding of the importance of moisture, sunlight, and soil by such questions as the following: "Why must the seeds we plant have moisture? Name two of the things that are needed by a plant in making its food. Are sunlight and water food? Why are they needed by a plant? What else does a plant need to make food?" If necessary, refer the children to pages 56-57 to remind them that materials in the soil are needed by plants for food-making.

It is essential that the pupils fully grasp the idea that plants require sunlight and moisture in order to make food but that sunlight and water are not food in themselves.

In order to demonstrate that water helps keep plants green, pupils should duplicate the experiment described at the bottom of page 61. Two well-developed green plants should be used.

A chart similar to that suggested in the preceding lesson plan, page 49, should be kept for the experiment. The pupils should record at stated times the condition of the plants, their size, color, etc., and the approximate amount of water and hours of sunlight they receive.

Page 62

Relation to the Unit: To promote ability to perceive cause-and-effect relationships; to promote ability to make inferences; to provide an opportunity for using experimentation to check the validity of an inference.

Concept:

A plant's roots take in the water needed in food-making.

Information for the Teacher: This page presents an opportunity for pupils to perceive that scientific experimentation often corrects erroneous ideas. It is quite natural for the pupils to assume that leaves soak up the water needed for food-making when it rains. No attempt should be made by the teacher to correct such an impression during the early discussion, for the children should be led to recognize their own misconceptions and to correct them.

When the pupils perform the watering experiment, choose plants which will show evidences of lack of water in a short time. The petunia, bean, tomato, and the everblooming plant called "impatiens" are desirable plants for this purpose. Geraniums, or other plants with woody stems that store water, will not show the lack of it for days. If a suitable house plant is in the room, use it for the experiment, as well as the plants grown from seed.

Be sure that the paper used as a collar around the base of the plant is water resistant.

The plants in the top picture are tulips. Those used for the experiment are petunias.

Procedure: The pupils should read the text that accompanies the first picture and answer the question. Most of them will answer in the affirmative. They should then read the remaining text and study the other two pictures. It must be clearly understood that in Picture 2 one plant is receiving water on the roots—that is, the water being poured on the soil will be soaked up by the roots—whereas the other

plant is receiving water only on the leaves, because the paper collar around the base of the plant prevents the roots from obtaining water.

When the page has been completed, the teacher should ask: "How many of you have changed your minds about whether leaves take in water when rain falls on them? Was it the experiment that made you change your mind?" Point out that experimentation often corrects wrong ideas and changes opinions based on guesswork. Then ask, "What parts of the tulip plants in the top picture are taking in water?"

Extending and Enriching Activities:

1. Duplicate the watering experiment, using several kinds of plants. The time element will depend largely on the size and thickness of the plants' stems and leaves. Keep a record of the experiment by recording data as suggested in the lesson plan on page 49.
2. As an aid in developing the idea that water carries, or conducts, the food-making materials from the soil to the leaves, explain that these materials are dissolved in the water absorbed from the soil. To clarify the meaning of *dissolved,* put a small amount of sugar or salt in water and have the pupils prove to themselves by tasting that even though the substance cannot be seen, it is in the water.

Page 63

Relation to the Unit: To demonstrate that water rises in plants.

Concepts:

A. Materials in the soil are utilized by plants in manufacturing food.

B. Leaves are the parts of a plant in which its food is made.

C. Roots take in water and food-making materials from the soil.

D. Stems conduct water and food-making materials to the leaves.

Information for the Teacher: Red ink should be provided for the experiment. Obtain a magnifying glass if possible. Its use will enable the pupils to see more easily the red lines which indicate the water-carrying tubes.

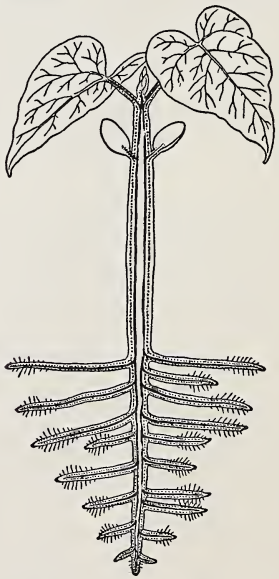
Procedure: The following facts have been developed previously: (1) Most of a plant's food is made in its leaves; (2) food cannot be made until water gets into the leaves; and (3) roots are the only parts of a plant that take in water.

A logical question evolves from these facts—How does water taken in by the roots get into the leaves? Pupils should perceive that this is the question which is implied by the title on page 63.

After they have read the title, the children should be aware that it implies a problem and that the pictures illustrate an experiment which will solve it. The text opposite the first picture will make it clear that they are to duplicate the procedure indicated. Young tomato or bean seedlings should be used for the experiment, and they should be inspected every half-hour until the colored water rises into the veins in the leaves.

After they have placed several plants in an ink solution, direct the pupils to study the other pictures on the page together with the text.

To show the tubes in the stem that carry water to a plant's leaves, draw on the blackboard the diagram below. For this purpose, use only the inner solid lines shown in the diagram. The dotted lines indicate the tubes which carry food down from the leaves to other parts of a plant.



If the pupils have been engaged in chemical gardening, they will understand that the chemicals they have been adding to water for the nutrient solution rise in the plants in the same

way in which the colored ink rises. However, it must be made clear that these chemicals are not in themselves food but are merely the materials used in the manufacture of food.

In order to review and stress the concepts concerning food-making, list on the blackboard the following statements:

1. Green plants make their own food.
2. Plant food is made in the leaves.
3. Water is needed to dissolve materials in soil and to conduct them to the leaves.
4. Sunlight is needed to make and to keep leaves green so that they can manufacture food.

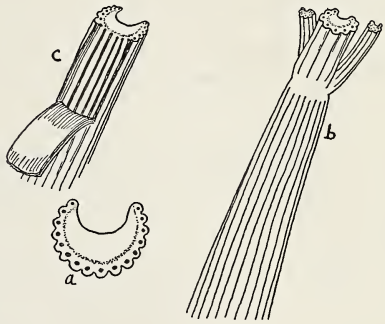
Before proceeding with the next lesson, have the pupils examine their plants in the ink solution. One to two hours should be sufficient time for the colored water to fill the veins as shown in the third picture on page 63. The color can be more clearly seen if the plants are held against strong sunlight.

At this point the teacher should have in mind the statement on page 66 of *How Do We Know?* that stems carry food made in the leaves to other parts of the plant. To insure adequate comprehension of this concept, she should direct the pupils to look again at page 60 and ask: "What is in the two halves of the seed? How do you think this plant food came to be in the seed?" Explain that a plant makes more food than it can use in growing and that the surplus is stored in the seed. Then ask, "What part of the plant carries this food from the leaves to the other parts of the plant?" The word *carry* as used in this connection means "conduct," and this should be explained to the children.

Use the diagram again to show the food-carrying tubes in the stem of the bean plant as well as the water tubes, adding the dotted lines.

Extending and Enriching Activities:

1. Press fresh leaves, preferably thick, fleshy ones, between the fingers to demonstrate that moisture is transferred from the leaf to the fingers. Break apart the stems of dandelions, milkweeds, or other live plants to show that the edges of the stems are wet. In like manner determine that water is in flowers, in fleshy fruits, and in the roots and seeds of vegetables.
2. Put pieces of celery stalks in water with a strong ink solution. Leave them in it for about two hours. Slice one of the stalks crosswise at various places. Colored dots indicate the presence of ink in the stem and show that the tubes extend throughout its length. (See Figures *a* and *b*.) Tear a stalk apart to show the ink-filled tubes that are imbedded in the stem (Figure *c*).



3. Read books that describe the making of syrup from sugar trees, the processing of rubber from rubber trees, etc. (See the Bibliography, pages 164-172.)

Page 64

Relation to the Unit: To review plant structures and their functions; to present and identify different types of roots; to give an opportunity to perceive likenesses and differences in plants; to promote the ability to make generalizations from observed facts.

Concepts:

A. The type of root system varies with the kind of plant.

B. Individual plants need growing space that will enable their roots to take in plenty of water and their leaves to get sufficient light.

Procedure: Direct the pupils to read the text and examine each plant shown. They should be able to recognize the distinguishing characteristics of each one and to associate the plant with its accompanying label.

Avoid a detailed analysis of the root systems but lead the pupils to perceive the fundamental differences between roots of such plants as beets and tomatoes, celery and corn, etc. Obtain vegetables, with roots intact, from gardens or

markets and compare them with the examples in the book. Dig up matured corn plants to observe the extent of the root systems.

The children should understand that if these plants grow too close together in the garden, their roots may not obtain enough water to carry food materials from the soil to the leaves and they may shade one another to such an extent that their leaves will not have enough light.

Turn back to pages 54-55 and direct the pupils to find additional reasons why Plot 2 is not desirable even though the soil is satisfactory. They should point out that the trees and hedge not only produce much shade but also require much moisture and thus would deprive garden plants near them of sufficient water as well as light.

To emphasize that when people eat plants they usually eat that part in which most of the food is stored, say: "Three of the plants on this page store most of their food in their roots. Which ones are they? Name the plants that have leaves which are good to eat. Which plants have both leaves and stems that are used for food? Which plants produce seeds that we eat?" Bring out that the green string beans we eat are seeds and seedcases.

Page 65

Relation to the Unit: To give an opportunity to apply science concepts developed in previous lessons to a new situation; to present pictorial and diagrammatic representations of a garden plan.

Concept:

A garden should be planned in order to provide full sunlight and sufficient growing space for the various kinds of plants.

Information for the Teacher: If the pupils are going to make their own gardens, careful planning is essential for success. The teacher should also keep in mind that a small garden, well planned and well cared for, is far more satisfactory than one so large that the pupils cannot possibly take care of it. The type of garden shown on page 65 is suitable for a family garden or for a community school garden. If the children are to have individual gardens, plots that are no larger than 8x10 or 12 feet are usually more satisfactory. Regardless of size, the plot should be spaded or plowed by an adult to insure the most satisfactory results.

For gardens where little or no adult help can be given, the following plants are suggested: vegetables—leaf lettuce, radishes, onion sets, carrots, beets, New Zealand spinach, Swiss chard; flowers—calendulas, giant zinnias, cosmos, dwarf nasturtiums, sweet alyssum, four-o'clocks, marigolds.

In case some adult help can be expected or if the project is to be a community one, these vegetables may be added: tomatoes (use plants rather than seed), bush string beans (green and wax), bush Lima beans, cucumbers, acorn squash. It should be kept in mind, however, that cucumbers and squash require considerable space and that such plants as tomatoes, beans, cucumbers, and squash require adequate spraying or dusting to control insect pests.

The amount of space to be left between rows should be determined not only by the kinds of plants but also by the type of cultivation to be used. Since the pupils will cultivate with hoes, the space between rows should be kept to a minimum. A foot to a foot and a half is usually adequate, unless tomatoes are to be grown. In this case, two and one-half to three feet should be left between the rows, and the plants should be staggered so that they will not shade one another. Such plants as Lima beans need more room than leaf lettuce. Squash and cucumbers should be planted in some area at the back or side of the garden where the vines can spread freely. The directions printed on seed packets usually suggest the space to be left between rows.

Procedure: The pupils should examine the garden picture at the top of the page and discuss the planting arrangement in general. They should then identify the plants in the garden picture from the plan underneath it. Explain that the top of the plan corresponds to the far end of the garden. The pupils should note that the plan is a diagram.

Then ask, "Why do you think the children made a plan for their garden?" Bring out that garden planning is essential in order to get a good variety of plants and to guarantee the best placement for sunlight, adequate growing space, and cultivation. Pupils with rural back-

grounds will understand at once the reason for planting most vegetables in rows, but city children may need help in understanding that row planting makes for ease in cultivation, etc.

The teacher should explain the need for using a certain scale in making a garden plan. If the pupils are mature enough to find the marks on their rulers that indicate fractions of an inch, explain the scale representation as follows: "The children we have read about in our book decided to make a diagram of their garden. They couldn't make their plan as big as their garden, so they decided they would let each eighth of an inch on their plan represent one foot in their garden." If the pupils need help in finding an eighth of an inch on their rulers, the teacher should help them. Then she should ask, "How many eighths of an inch are there in one inch?" It must be clearly understood that each inch on the plan represents eight feet in the actual garden, and the length and width of the garden should be worked out according to the scale.

If a scale involving fractions is too advanced for the group, work out the plan on the basis of one inch being equivalent to a foot of space in the actual garden.

When the scale has been decided on, the answers to the following questions may also be determined: "How wide is the path? How far apart did the children set the tomato plants?"

Extending and Enriching Activity:
The pupils should plan their own gardens, making scale diagrams of the plots and working out their planting programs according to information derived from the study of this page. This planning activity should involve research as to (1) the proper planting dates for the region, (2) places where plants can be obtained, (3) latest frost dates, and (4) spacing between rows and between plants. In computing the spacing between the plants in a row, it should be kept in mind that plants with large root and leaf systems need more room in the garden than do small-rooted plants such as green onions, etc. If real gardening projects are practicable, plan for a vegetable show to be held in the fall.

Pages 66-67

Relation to the Unit: To review the functions of plant structures; to develop the ability to analyze and compare distinguishing physical characteristics of plants.

Concepts:

A. Leaves, stems, and roots have distinguishing features by which plants can be identified.

B. Leaves, stems, and roots have specific functions in food-making.

Procedure: If the season permits, live plants should be brought into the classroom for examination as these pages are studied. These specimens may duplicate the pictured examples and also include other kinds of plants. It is important that some vines be included in the specimen collection. If the work of the unit is carried on during winter, use house plants and plants grown indoors from seed. Cut branches or twigs from trees and place them in water so that the leaves will unfold.

After the pupils have read the title, inform them that on these two pages they will review what they have learned about leaves, stems, and roots and, at the same time, learn something new. They should examine the leaves in the first row and identify them with the printed names. (The fact that a beet leaf has red veins should not be confused with the red ink experiment.)

If live specimens are available, compare the leaves of the real plants with the pictured ones in order to answer the first question. The pupils' analyses of the distinguishing characteristics of leaves should be fairly detailed. They should notice the differences in vein arrangements, the kinds of edges—whether smooth or notched—and the general shapes of the leaves. It should be clearly understood that, with all these differences, leaves have a common characteristic—they make the plant's food.

The teacher may, if she finds the pupils sufficiently mature, teach the terms *simple leaf* (beet) and *compound leaf* (locust and hickory). It should be pointed out that both the simple leaf and the leaflets of the compound leaf have different types of margins—some being smooth, some toothed, and some lobed (maple). If specimens of plants other than the ones

pictured have been brought to school, compare and contrast their leaves with the examples in the book.

While discussing the different kinds of stems, the pupils should examine real plants that have stems like each type pictured. They should notice that while many stems are stiff and brittle and break easily, some are woody and tough and others are flexible. Call attention to the water-lily stems in the picture and guide the group to perceive that the flexibility of the stems permits them to "give" as the water currents pass, and so the plant is not jerked out of the soil.

The stems of schoolroom plants and plants seen on the way to school should be examined, and their differences should be analyzed and compared. The tough, woody stems of various shrubs may be compared with the brittle stems of nasturtiums or snapdragons and the meaty stem of the asparagus or rhubarb. Common vines such as Boston ivy, morning-glories, silver-lace vine, and English ivy should be examined so that the pupils may observe how vining stems fit a plant to climb and spread and thus get its leaves into the light.

During the reading of the text make sure the children interpret the word *carry* as "pass" or "conduct." After the question "Which stems do we eat?" has been answered, ask: "In what ways are the stems of these plants different from each other? In what way are they alike?" To stress how stems function in food-making, use the diagram on page 51 of this *Guidebook*. Have the pupils trace the paths of the tubes through which water goes up and of those through which food goes down to other parts of the plant.

In discussing the roots in the third row, the pupils first should be aware that root systems vary in size and shape. Then they should analyze further and perceive that grass and corn have a mass of roots all about the same size. Corn roots are often several feet long, but the picture emphasizes the general type only. Call attention to the fine rootlets on each long root and bring out that they help the plant obtain moisture. A young corn plant and grass plants with roots intact should be used for this study. While examining the corn roots, the pupils should be told that the extra roots growing out above the main root system serve only as support and are called "prop roots."

Both the clover and violet have a thickened root base with several long roots branching out from it. Each root has many rootlets along it. Some children who have a farm background may know that the tiny nodules, or balls, on the clover roots contain one of the "things in the soil" that plants need for making food. If this is mentioned, explain that this mysterious "something" passes from the clover roots into the soil so that the next crop is benefited by it.

Both the radish and the turnip have a single main root (taproot) growing downward. This root is thickened by the food that is stored in it. The sweet potato also has a taproot, but instead of a single thickened section it has several. If the question arises, point out that the edible part of a sweet-potato plant is the root but that this is not true of the white potato.

Ask, "Why do you think that a plant needs so many rootlets?" Answers should indicate an understanding of the following facts: (1) it takes a great deal of moisture to enable the plant to make as much food as is stored in all the potatoes on one vine; (2) without many rootlets the plant could not soak up enough water.

After identifying the edible roots as the text directs, the pupils should turn back to page 64 and compare the roots shown there with the ones on pages 66-67.

Before proceeding to pages 68-69, the pupils should again refer to the diagram of a plant's conducting system. Lead them to observe that the water and food tubes extend down into the main root but are absent from the rootlets. Explain that water is absorbed, or soaked up, by the rootlets and root hairs and then passes into the water tubes in the main root and stem.

To make clear what is meant by the term *absorb,* or *soak up,* have the children perform this experiment:

> Fill a pan with water and put one end of a short strip of cotton cloth into it. The strip should be held upright, with not more than an inch of it in the water. Note that the portion of the strip placed in the water becomes very wet immediately, while the rest of the strip is still dry, but that the water gradually spreads through the threads of the cloth until all the cloth is wet. The end of the strip held in the fingers may then be placed inside a small glass jar, which should be set beside

the pan. In a few minutes the water will drip from the cloth into the jar, thus demonstrating that water passes from one place to another by the process of absorption.

Extending and Enriching Activities:

1. Make a collection of various kinds of live plants. Learn their names and compare their leaves, stems, and roots with the ones in the book. Group the live specimens according to the type of leaf, stem, or root. The pupils should dig up the entire root systems of several kinds of plants—dandelion, carrot, corn, grass, sweet potato, dahlia, ragweed, etc. They should dig deep and take plenty of earth, so that the root systems will be intact. Newspapers should be wrapped around the earth while the plants are being moved. The dirt can be washed away when the pupils are ready to examine the roots. After this experience it should be easy to perceive that the roots of a plant hold it in the soil.
2. Make booklets, a chart, or a bulletin-board display of garden plants. Drawings, paintings, or cutout pictures of plants from seed catalogues may be used. Label each plant and list the parts of the plants that we eat. Such an activity should extend through the study of pages 68-69.
3. Start a collection of leaves for a leaf book. The leaves should be pressed and mounted on large sheets of paper by means of narrow strips of gummed tape. The name of the tree or other plant from which the leaf was taken should be placed on the page. The book may be a coöperative project, or each pupil may make his own.
4. Obtain copies of the first two books in this series, *Look and Learn* and *All Around Us*, and allow the pupils to identify, examine, and compare the stems and leaves shown in the plant units with pages 66-69 in *How Do We Know?* Also use reference books on trees, wild flowers, and garden plants in this activity. (See the Bibliography.)

Pages 68-69

Relation to the Unit: To review the functions of plant structures; to promote the ability to analyze and compare characteristics of plant structures.

Concepts:

A. Flowers are identification features of plants.
B. Flowers produce seeds.
C. Seeds serve as storehouses of plant food and produce new plants.
D. Bulbs serve as storehouses of plant food and produce new plants.

Information for the Teacher: The fact that the generic term *fruit* means any product of the flower that contains the seed is not presented in the text, since to most children the word *fruit* means only fleshy fruits—peach, orange, etc. However, if the pupils can grasp the generic meaning without confusion, use it in this lesson. Explain that a fruit is the product of the flower, whether that product be the green bean pod and seeds or the cherry.

Ascertain whether any pupils associate the word *flower* with decorative flowering plants but not with vegetables, trees, etc. Be sure the meaning of *flower* is interpreted as blossom.

Procedure: After they have read the title, the pupils should be made aware that these pages stress the functions and the likenesses and differences of flowers, seeds, and bulbs. They should examine the flowers of each plant in order to answer the first question on the page and then identify each one with its name.

Flowering plants—weeds and garden plants as well as ornamental ones—should be brought into the classroom and compared with the pictured ones. The number of petals should be counted, the color and markings noted, the general shape described, etc. Thus the pupils will become aware that different kinds of plants produce different kinds of flowers. They will also perceive that plants of the same species produce flowers of different sizes and colors but that there is a similarity in shape and in the number of petals which distinguishes the species.

The fact that shade trees have flowers may be unknown to most children. The teacher should find out whether the pupils have ever noticed flowers on the trees about them. Likewise, the fact that the portion of the cauliflower plant which we eat is composed of flowers may be startling. Bring a cauliflower head into the classroom and dissect it to show the formation of the flowerets.

The vital science concept to be perceived by the pupils at this level is that the flower produces the seed (or fruit—if the generic meaning of the term *fruit* is understood). There is no need to teach the part names of the blossom, other than *petal.* However, there may be some children who would be interested in a more detailed analysis, in which case the teacher may use any general botany text as a reference in presenting the information.

In the study of seeds in Row 2 the teacher should be sure the children notice that the seeds are the products of the flowers shown in Row 1.

Point out that the hickory nut has an outside husk and a hard shell. Obtain various kinds of nuts and compare their coverings.

If the generic meaning of the term *fruit* has been developed, the teacher should bring out that all the seeds in Row 2 are fruits.

Before concluding the discussion of seeds, be sure the pupils understand that in spite of the differences among the seeds, there is a characteristic common to all of them—each one contains an embryo plant and the stored food that is needed to nourish it.

In the study of bulbs the teacher should dissect several of them to show that (1) the bulb contains a bud (leaf, flower, or combination of both), (2) the bud is surrounded with fleshy layers or scales containing food, and these are fastened to the base or flattened stem from which the roots grow. She should explain that under favorable conditions the bud begins to grow, using the stored food in the fleshy scales until it is able to make food. Then as the plant grows, it produces leaves and a flower. After the flower blooms, a flower and leaf bud is also produced inside the bulb for the next season.

Extending and Enriching Activities:

1. Grow bulbs such as paper-white narcissus in water, using pebbles or moss to support them.
2. Dissect various kinds of bulbs—narcissus, onion, tulip, hyacinth, daffodil—to show that each one contains fleshy leaves and a bud from which a new plant will grow. Compare a dissected bulb with a piece of potato to demonstrate that a potato is not a bulb.
3. Place sweet potatoes in jars of water, but do not submerge them. The sprouting and growth of new stems and leaves should be accepted as evidence that the potato contains food.
4. Crack open the shells of seeds such as those of the peach, cherry, acorn, and filbert to show the part from which the new plant grows.
5. Examine, identify, and compare the flowers and seeds shown in the plant units of *Look and Learn* and *All Around Us,* the preceding books of this science series. Nursery catalogues and reference books on garden and wild flowers, trees, fruits, and seeds (see the Bibliography) may also be utilized for this activity.
6. Continue the chart suggested in Activity 2 for pages 66-67.
7. If this lesson is presented in the spring, take excursions to observe various kinds of trees and other plants in blossom. If the season is autumn, collect seeds and seed pods from trees and other kinds of plants. On all excursions warn the pupils to avoid touching poisonous plants, such as poisonous varieties of ivy, oak, and sumac. (See the Appendix, page 161, for illustrations.) Group the collected seeds on the basis of whether they have hard shells, fluff, etc., or whether they are in pods. Make this collection a part of the permanent science exhibit.
8. Press the dry flowers from many kinds of plants or cut pictures from seed catalogues to make a flower book.

Pages 70-71

Relation to the Unit: To present the fact that plants as well as animals have enemies; to define the term *enemy* in relation to plant life; to define the term *weed;* to identify plant and animal pests.

Concepts:

A. Some insects destroy the leaves and stems of plants.

B. Weeds are plants which are of no value to a gardener, and they retard the growth of useful plants.

C. Plants are protected by man so that he can derive food and pleasure from them.

Information for the Teacher: The pictures of the cabbage worm and tomato worm are about life size; the cutworm and corn-ear worm are twice the life size; the leaf hopper and chinch bug, nine times; the Mexican bean beetle, three times; the striped cucumber beetle, five and one-half times; and the pink and green tomato lice, six times.

Insects with biting and chewing mouth parts are controlled with stomach poisons—often a form of arsenate. Sucking insects must be destroyed by a contact insecticide such as nicotine sulphate. Insecticides such as DDT, which will kill both biting and sucking insects, have been developed.

Procedure: Before the books are opened, say to the group: "Today we are going to learn about enemies of plants. What do you think might be an enemy of a plant?" (anything that harms or destroys plants) "Some animals are plant enemies. Why? What kind of animal might be a plant enemy?" (any plant eater is a plant enemy) Have the pupils turn back to the first unit of *How Do We Know?* and find some plant enemies. They should perceive that the beaver, for example, is a plant enemy because he destroys a tree when he cuts it down; the bluejay is a plant enemy because he reduces the plant's chances to multiply itself when he eats seeds.

Continue the presentation by saying, "The plant enemies we are most concerned about are those that injure or destroy useful plants. Name some kinds of plants that are useful to us." Pupils should name plants that feed us, create beauty, or serve other useful purposes, such as furnishing lumber for houses and material for clothing. Then say: "Open your books to page 70. The animals on this page are a few of the many animal enemies that attack garden plants."

The pupils should read the text and follow the directions. Help them identify each animal by name and have them tell which part of the plant is being eaten. Continue the presentation as follows: "The animal in the first picture is eating a cabbage leaf. Have you ever seen what happens to a cabbage plant if these caterpillars are not destroyed? What is made in the green leaves of plants? Why will a cabbage plant die if its green leaves are destroyed? Is the cabbage worm a plant enemy?"

Proceed with this type of development, making sure that pupils understand that animals which destroy leaves make it difficult for the plant to make food and that animals which bore into stems or suck them cause the water, which carries essential food materials, to escape. Borers and sucking insects are injurious for other reasons, but these reasons need not be discussed at this time.

Common beneficial insects are the praying mantis, lady beetles, ground beetles, many varieties of wasps, etc., because by one means or another they destroy many harmful insects. Other plant friends in the animal world are such animals as toads, frogs, bees, etc.

Proceed in much the same manner with page 71, being sure that the pupils understand that weeds are undesirable in the garden not only because they take much of the moisture away from the desired crop and tend to shade it, but also because they provide breeding places for harmful insects.

Point out that, with the exception of the plantain, there are two pictures of each plant—one to show the root system and the other to show the top part bearing the flowers. Discuss the differences of these roots and their common characteristics. Then ask: "Which plants have roots most like corn roots? Do any of these weeds have a thickened root where plant food is stored?"

Similarly the root systems of these weeds should be compared with the roots of the plants on pages 64 and 66-67. Reference books on weeds also may be used in this activity. (See the Bibliography.)

Extending and Enriching Activities:

1. Look back through Unit 1 and find animals that are helpful to man because (a) they destroy insect pests, and because (b) they eat weed seeds. Find those that are troublesome to man because they destroy the plants he wishes to grow.
2. If this lesson is presented in the spring or fall, the pupils should obtain live insects to put in an insect cage. Thus the food habits of various insects may be observed. (See the directions in the Appendix, page 156, for the preparation of such a cage.)
3. Look through lists of publications of the Dominion and Provincial Departments of Agriculture for titles of pamphlets describing the

role of birds in controlling insects. Many bird books also show the value of birds to farmers and gardeners. Make posters of birds and insects captioned "Friends to Man." Arrange for the display of such posters in the community.

4. Find out what can be done to control insect pests in the garden. The Departments of Agriculture have bulletins that supply information on dusting and spraying, and most manufacturers of commercial sprays will provide folders and other information.
5. Discuss ways in which weeds can be kept out of the garden. The pupils should be aware that hoeing, cultivating, and hand-weeding will cut down the existing weed crop—destroying the weeds before they go to seed. By experimentation or through information given by the teacher, pupils should find out which weeds can be killed by one cutting and which ones grow again from the roots. (See the Bibliography for reference books on weeds.)

Page 72

Relation to the Unit: To review concepts previously developed in the unit; to give the teacher an opportunity to determine the pupils' ability to apply scientific knowledge to a practical situation.

Procedure: The children should answer each question and should be able to justify their answers. They have learned that tomatoes have a fairly large root system and that they have a large leaf-spread. Hence, if the tomato plants are to have sufficient room for their roots and enough space for their leaves to get the necessary sunlight for food-making, individual plants must be allotted more ground space in the garden than a compact plant such as leaf lettuce or the onion.

Point out to the pupils that the black areas on the cabbage leaves in the picture indicate holes which worms have made. These areas look black because the ground shows through the holes. Since the cabbage worms are the same color as the leaves, it is difficult to see them in the picture. However, the two worms on the leaves in the foreground should be noticed.

Extending and Enriching Activities:

1. Upon completion of the unit, the pupils should engage in an activity that will summarize the main concepts developed in it. If the instruction has been timed so that the unit has been studied during or immediately prior to the local gardening season, the best summarizing activity is, of course, the making of a garden according to the plan on page 65 of *How Do We Know?* Reports on surveys of possible garden spots should be made, and the problems concerning the work involved in preparing the plots for cultivation should be settled.
2. A garden show may be planned for the fall season as an added incentive for pupil interest in a summer garden project.
3. Compilation of a book of hints for young gardeners may be a suggested project to follow the summer gardening activities. Some of the illustrations may be kodak pictures showing the garden in various stages of growth.

UNIT 4: Wheels and Levers

General Concepts

A. Wheels and axles are used in various ways to make work easy.

B. The lever reduces the force needed to lift objects and thus makes work easy.

(For a more detailed outline, see the Index to Concepts, page 96 of *How Do We Know?*)

Page 73

Relation to the Unit: To present the concept that wheels are different in size and style but all wheels are alike in one way—they have curved perimeters or rims.

Procedure: After presenting the title of the unit, have the pupils examine the wheels on page 73 and tell where they may have seen similar ones—on wagons, bicycles, automobiles, engines, etc. Special attention should be called to the intermeshing cogwheels in the upper-right corner, since these will be presented later on in the unit and may be new to many children. If cogwheels are unfamiliar to the pupils, they can be observed most easily in a watch or clock movement.

Because levers are not pictured on the unit title page, say: "We will learn about levers in the last part of the book. They are machines that we use very often to lift things." Then demonstrate how a lever operates, for example, by lifting a book with a ruler and using an eraser, box, or book end as the fulcrum.

Draw attention to the differences among the wheels by asking: "Are all these wheels the same size? Do all of them have spokes? Which wheels have spokes? Do any two of them have the same number of spokes? Which wheels are most alike? What do you think each wheel might be made of? How do you think each kind of wheel can be used to help do work? What is the shape of each wheel? Are wheels round all over like a ball? Where is the rounded part?"

In answering the last question guide the pupils to perceive that a wheel is like a circle, that its outside frame or rim is circular. Then have them name other objects that are circular. Some pupils are not aware that wheels turn on an axle, and this concept should not be forced at this time.

Pages 74-75

Relation to the Unit: To provide experience with different kinds of roundness; to relate the quality of roundness with the ability to roll; to promote the ability to classify on the basis of likenesses.

Concepts:

A. Objects having the quality of roundness will roll.

B. Spherical objects roll on any part of their surfaces.

C. Cylindrical objects roll only on the curved side surfaces.

D. Circular objects roll only on their curved perimeters, or rims.

Information for the Teacher: When possible, it is preferable to present pages 74-75 as a unit during one lesson period. However, if the length of the science period does not permit this procedure, page 74 may be presented alone; and during the lesson only the quality of roundness and its relation to rolling should be presented. Thus, no distinction between the ball and the glass in Row 1 should be made, and discussion of the different kinds of roundness should be postponed until page 75 is studied. After the study of page 75 has been completed, the pupils should return to page 74 and distinguish between types of roundness.

Real objects—balls, cylinders (bottle, drinking glass, mailing tube), and disklike objects (plate, phonograph record, can lids)—should be on a table where they can be handled.

Procedure: The pupils should read the text on page 74 and follow the directions. To clinch the concept that all things that roll are round, the teacher should ask, "What kind of things will roll?"

The pupils should handle objects similar to

those shown on page 74 and actually feel the difference between the rounded surface of a ball and the flat surface of a block. It is particularly important that they handle a cylindrical article, such as a glass, a mailing tube, a rolling pin, etc.

Often merely handling a cylindrical drinking glass will cause some pupils to say, "This wouldn't roll if you stood it up on the flat bottom." Such remarks give the teacher excellent introductions to the main concept of page 75. She should immediately ask why the glass will not roll when it is in an upright position, thus leading the children to see the difference between flatness and roundness from the standpoint of rolling.

When the study of page 74 has been completed, the pupils should handle a pencil, a ball, and a wheel as each question is asked.

It is not necessary for the teacher to present the terms *sphere, cylinder,* and *circle,* but it is essential that the children see the difference between spherical, cylindrical, and circular objects. It is satisfactory at this level if the children characterize these differences in terms similar to the following: "Things like balls are round all over; things like pencils have round sides; things like wheels have round edges, or frames."

The pupils should experiment to determine which objects roll. They should perceive that spheres roll on any part of their surface and thus roll in any direction; that cylinders and wheels or disk-shaped objects roll only on their curved edges.

Extending and Enriching Activities:

1. Any number of games can be devised to stress the relation of roundness to rolling and to distinguish between types of roundness. Pupils may be blindfolded and handed various objects, such as balls, blocks, dishes, books, etc. After they have handled each object, they should decide whether it will roll. A child may describe various objects while the other members of the class try to guess the names of the objects and tell whether they will roll.
2. The pupils may make classified lists of objects having the quality of roundness, grouping names or pictures of objects that have similar kinds of roundness.

Pages 76-77

Relation to the Unit: To present the idea that one important use of wheels is to move loads; to demonstrate that there is much resistance to motion when a flat surface is moved across another flat surface and that there is little resistance to motion when a curved surface is rolled across a flat surface; to demonstrate that wheels cannot function without axles.

Concepts:

A. Objects having the quality of roundness are easier to move than objects with flat surfaces only.

B. Wheels must have axles in order to turn.

C. Wheels are used to reduce the force required in the moving of loads from place to place.

Information for the Teacher: It is recommended that pages 76-77 be presented as a unit if the length of the science period permits. However, if this is not possible, page 76 should be quickly reviewed before page 77 is presented, so that the pupils will clearly understand the value and function of wheels in the situation depicted on page 77.

Procedure: Direct the pupils to read the title. Then ask: "What is the man in the first picture doing? Do you think the box is hard to move? Why do you think so?" After the pupils have discussed the man's evident muscle strain, they should read the text on page 76 and answer the questions. Have them give reasons for their answers. In the discussion be sure the pupils understand that the objects being moved are just as heavy when mounted on wheels as they are when being moved without wheels.

In order that the concepts presented on this page may be fully understood, demonstrations comparable to the pictured ones should be conducted.

Fill a large box with books or other available heavy objects. Be sure that the box, when filled, is too heavy for one child to move. While the box rests flat on the floor, one child should endeavor to move it. (Since there is the possibility that someone might attempt to show off his strength and hurt himself, the teacher should carefully supervise this activity.) Then another child should help him try to push it, then another, and so on, until enough children have been grouped together to move the box.

The number required to move it should be counted, and those who pushed should report on how hard it was to move the load.

The box should then be mounted on wheels. An easy way of doing this, without having to unload the box, is to divide two skates at the center coupling, so that four sets of wheels are obtained. Then pry up the box and slip one portion of the skates under each corner of the box. When this has been done, the class should experiment to find out how many children are required to move the box. This number (probably only one) should be compared with the number required previously.

At this level it is advisable to avoid explaining the difference between rolling friction and sliding friction. The concepts involving friction should be kept on the observational level. For example: It is easier to move objects on rolling wheels than it is to slide them across a surface.

The first picture and its accompanying text on page 77 should be studied and the questions answered in light of the concepts developed on page 76.

Call attention to Picture 2, in which the wheels are fastened to the box but do not function. Have the pupils read the accompanying text and answer the question. Make sure they know that the wheels cannot turn because of the two nails in each wheel.

Have the pupils read the text opposite Picture 3, giving help with the new word *axles*. Then ask, "How can you tell from the picture that the wheels can turn?" Be sure the pupils see that the wheels are attached, through the centre, to the axle in a way that permits them to turn freely about this centre rod or axle.

The children should perceive that the axles are fastened firmly to the box and do not turn. It is not necessary to point out at this time that some axles rotate with the wheels, since this is presented in a later lesson.

An actual experiment should be performed by the pupils. Can lids may be used for wheels and a small wooden or pasteboard box for a wagon bed.

Extending and Enriching Activities:

1. Bring various wheeled toys to school and examine the axles.
2. In order to understand more fully the function of the axle, the pupils should move a box of books with two rollers. They will perceive that the rollers, like wheels, make it easy to move the load and that the rollers are less efficient than wheels because they do not stay under the box as it is pushed or pulled.
3. The pupils may build toy wagons, using old roller-skate wheels for wagon wheels. This activity will make clear the reason why axles must be made fast to the object to be moved.

Pages 78-79*

Relation to the Unit: To extend knowledge of the function and uses of the wheel and axle; to review the idea that wheels need motive force in order to turn; to give practice in interpreting explanatory text.

Concepts:

A. Some wheels are turned by human or animal muscles; some wheels are turned by motors.

B. Some wheels help do work by rolling objects from place to place.

Procedure: Before these pages are presented, a scooter and a tricycle might be brought to school. Let children demonstrate the difference between making a scooter go and making a tricycle go. After pupils have read the title on page 78, they should engage in a short discussion of the ways in which wheels are being used in each picture. Then they should read the text and answer the questions on page 78. Their answers should indicate that the force applied by the boy's foot against the ground pushes the scooter forward. The horses pushing against their collars pull the hay-rake forward. Gasoline engines supply force to turn the motorcycle wheels and the airplane propellors which pull the airplane forward. Discussion should include other examples of muscular and motor force used in making wheels turn—bicycles, wheelbarrows, motor scooters, wagons, trains, streetcars, lawn mowers, etc.

Before continuing with page 79, ask a pupil to demonstrate with the tricycle that when the axle of the front wheel turns, the wheel turns with it. This can be more easily shown by

turning the tricyle upside down and pushing a pedal by hand.

The pupils should then study the picture of the tricycle and the accompanying text. Their answers to the question should show perception of these facts: The force, applied by the boy through the pedals, turns the axle of the main wheel of the tricycle; as the axle turns, the large wheel turns; the back wheels follow the front wheel without direct force being applied to them.

Direct the pupils to study the picture of the toy and the text. In answer to the question, a response such as "When the axle turns, the monkey's legs will move" is acceptable at this time. It should be clearly brought out that the force which causes the monkey to somersault over the axle is not applied directly to the toy animal. The teacher should bring a similar toy to school, or help the pupils build one, in order to demonstrate that the monkey somersaults when the axle rotates. The toy itself is fairly easy to construct. Wooden disks can be used for wheels, and the sections of the animal can be cut out of thin wood with a jigsaw. The sections may be joined with wooden pegs and made fast to the axle with staples. A more temporary toy can be made from cardboard. Cut the animal from heavy construction paper, join the leg sections with paper staples, and use lids from oatmeal boxes for wheels. Fasten the animal to the axle with tacks, leaving enough room for it to rotate on the axle without touching the floor or table.

Page 80

Relation to the Unit: To extend knowledge of the function and the motive power of wheels; to develop ability to read and make use of explanatory text in the interpretation of pictures.

Concepts:

A. Some wheels help do work by turning round and round in one place.

B. Some wheels are turned by the force of wind or moving water.

Procedure: After pupils have read the title on page 80, they should discuss the ways in which wheels are being used in each picture. Then have them read the text and answer the question. The actual axles of some of the wheels are not visible. However, it will be sufficient if pupils point out the indications of a centre rod on each wheel.

Each picture clearly indicates the force by which the wheels are being turned. After the pupils have discussed this topic, in answer to the question they should point out the two kinds of motive force that are not portrayed on pages 78 and 79. Then the teacher should ask, "How are these wheels all alike?" In answering this question the pupils should be led to perceive that in each example on page 80 the axle is attached to some object that does not move from place to place when the wheel turns.

Next they should be asked to tell how these wheels differ from those on pages 78 and 79. Their statements should imply that the difference is as follows: The wheels on pages 78 and 79 support objects on the ground, and when they turn, the objects move along the ground; but on page 80 none of the wheels touch the ground.

Extending and Enriching Activities:

1. Survey the school and homes for examples of wheels that are attached to stationary objects and discuss how each wheel operates. The function of the wheel and the force that drives it should be brought out.
2. Pupils should search through newspapers and magazines for pictures showing wheels in use. These should be discussed by the group, and those that are the most interesting should be displayed with appropriate, printed captions. (See the Bibliography for titles of books about wheels.)

Page 81

Relation to the Unit: To extend understanding of the uses of wheels; to demonstrate that force applied to one wheel can be transferred to other wheels; to develop ability to read explanatory text in order to interpret a pictured situation.

Concept:

A wheel can be used to turn another wheel by means of a belt.

Procedure: Before presenting this page, the teacher may have the pupils describe all the mechanical toys they own. Toys that operate in a way similar to the one at the top of page 81 should be brought to school for demonstration purposes. In order to be sure there will be an actual toy which is comparable to that one, the teacher might bring one herself.

Then the teacher may introduce the page by saying: "The next page in our book shows another toy that has wheels. What is the title of this page?" After they have read the title, the pupils should be allowed to comment on the pictured toy and speculate on the way it works. The study of the text and the picture should bring out these understandings concerning the toy: All four wheels roll along the floor; Wheel 1 provides the force for Wheel 2; the axle of Wheel 2 turns when its wheel is turned by means of the belt connection with Wheel 1; the man's hands go around and around because they are fastened to the axle of Wheel 2.

Proceed to the study of the wheels on the bicycle. Have the pupils read and follow the directions of the text and answer the question. Stress the fact that the chain is a kind of belt and explain that the open places in the chain fitting over the teeth on the wheels keep the belt from slipping off. Call attention to the grooves in Wheels 1 and 2 on the toy that keep the belt from slipping off.

Bring a bicycle into the schoolroom to demonstrate how it operates. Study of the actual bicycle and of the picture and text on page 81 should bring out the understanding that the force is transmitted to the back wheel by means of a chain and that when the back wheel turns, the bicycle moves forward, thus making the front wheel turn. Contrast the way in which bicycle wheels operate with the way those of the tricycle work. In the case of the tricycle, the force is applied to the front wheel, and the back wheels follow.

Extending and Enriching Activities:

1. Examine the mechanical toys brought to the classroom and demonstrate how they operate. The pupils should determine what kind of force is used, to what wheel or wheels it is applied directly, and how the force is transmitted to other parts of the machine.
2. Build toys that operate on the principle of force transmitted by wheels and belts. Tinker-toy equipment, spools, and other types of children's building equipment can be used for such an activity.
3. Discuss examples of belt-driven wheels such as washing machines, sewing machines, and the fan wheel attached to the engine of the family car. Farm children will be able to describe farm machinery with belt-driven wheels and axles and may bring pictures from agricultural magazines.
4. Continue the picture-collecting suggested in Activity 2 of the lesson plan for page 80. Add to the collection examples of belt-driven wheels. Farm-machinery catalogues can be obtained for this activity.

Page 82

Relation to the Unit: To extend understanding of the uses of wheels; to extend knowledge of the ways in which force used to turn one wheel can be transferred to other wheels; to develop ability to read and make use of explanatory text in interpreting pictures.

Concept:

One wheel can be used to turn another by means of teeth or cogs which intermesh.

Procedure: Before reading the text, the pupils should discuss the toy wringer and the work that will be done when the handle is turned. Further discussion should be stimulated by these questions: "Where is the handle attached? Where have you seen a machine like this toy? Who has a toy like this?" As they read each paragraph, the pupils should discuss it in light of details shown in the accompanying picture. Study of the first picture should bring out that the wheels and axles turn together when the force is applied to the axle.

In answer to the question "How do these help do work?" pupils' responses should indicate that they understand that the cogs or teeth of one wheel fit between the cogs or teeth in the second wheel and thus when one wheel and its axle turns, it turns the other wheel and axle, thereby making an efficient machine that squeezes water from wet garments.

After the third picture has been studied and the questions have been read and answered,

stress the fact that these cogwheels turn in different directions, whereas those connected by belts turn in the same direction.

A real or toy laundry wringer may be brought to the classroom in order to demonstrate the way in which it operates. The pupils should observe the directions in which the cogwheels and rollers (axles) turn, where the force is applied, and how the force is transmitted from one wheel to the other.

Page 83

Relation to the Unit: To present further examples of the uses of cogwheels in machinery.

Information for the Teacher: If there is any difficulty in identifying the machines with their names, the teacher should give the necessary help. She should also explain how the machines work.

A rotary egg beater, similar to the one shown, should be used to introduce the group to the more complicated examples of cogwheels.

Procedure: Direct the pupils to examine each picture and tell what work is being done. Point out that the artist who made the pictures left the side of the tractor open in order to show the motor and left a part of the frame of the orange squeezer open in order to show the cogwheel.

By turning an egg beater very slowly, the pupils can perceive the manner in which cogwheels intermesh and the way in which the motive force is transmitted to the vertical axles, thereby turning the pieces of metal that do the beating.

The pupils should make the following observations about the churn: The axle in the motor, which is operated by electricity, turns the lower wheel and its axle by means of a belt; the axle of the lower wheel turns the upper wheel and its axle by means of another belt; the axle of the upper wheel is fastened to the framework of the churn, and thus it transfers its motion to the churn, making it turn over and over. If necessary, the teacher should explain that butter is made when cream is agitated for a certain length of time.

From the study of the centre picture the pupils should derive the following understandings: The force is supplied by the tractor's engine, which turns the shaft, or axle, that is attached to it; the force is transmitted, by means of the belt, from the shaft to the long axle that is attached to the sawing wheel; the sawing wheel turns with its axle and thus saws the wood.

The taffy-pulling machine is more complicated than the other examples, but by a careful study of the picture, pupils can perceive that it works as follows: The force is received from the electrically operated motor, which turns two wheels; the force is transmitted by means of chain-belts to the two upper wheels; the axles of these upper wheels turn with their wheels and rotate the taffy-pulling arms attached to them.

While studying the orange squeezer, the pupils need not be confused by the fact that the cogwheel meshes with the cogs of a bar instead of the cogs of another wheel, since their attention is still centred on a cogwheel that moves another part of a machine. They should be led to describe the manner in which the orange squeezer operates as follows: The force is provided by human muscles; the force is exerted downward on the handle fastened to the axle of the cogwheel, thus causing the cogs of the wheel and the bar to mesh; as the cogs of the wheel and the bar mesh, the top part of the squeezer is forced down, and the pressure on the orange forces out the juice.

Bring an orange-juice extractor of this type into the classroom so that the pupils may examine and operate it.

If possible, the group should be taken to see one or more of the other types of machines shown. Taffy-pulling machines are used in many candy factories. Motor-driven churns are used in some farm homes and in small creameries. The casing that covers the cogwheels in a lawn mower can be removed to reveal how cogwheels work in that machine.

Page 84

Relation to the Unit: To demonstrate that a wheel can be used to help raise objects.

Concepts:

A. The pulley is a kind of wheel.

B. The pulley provides a convenient way to exert force in moving an object from one place to another.

Information for the Teacher: At this level it is preferable to stress only fixed and single pulleys. However, some pupils may have had an opportunity to observe movable and multiple pulleys in use. In this case the teacher may discuss such pulleys at the conclusion of the study of pages 84 and 85, explaining that by their use heavy loads are more easily lifted than by the use of single, fixed pulleys. However, the pupils should be made to understand that a fixed, single pulley does not reduce the force required to lift the weight. Such a pulley merely provides a more convenient way of utilizing force in change of direction—it enables one to lift an object by pulling down.

Before presenting page 84, provide a single pulley for the pupils to use in lifting weights and thus check the information presented in the book by actual experiments.

Procedure: Have the title read and direct attention to the top picture so that, first of all, the pupils will see the kind of wheel to be studied. They should note that the central point about which the wheel rotates serves both as an axle and as a means of fastening the frame to the wheel. The text opposite the top picture should then be read by the pupils. Each statement should be checked, first with the picture and then with the real pulley.

The work being done with the pulley in the second picture should be discussed. Ask, "What did the man on the ground have to do to make the pail go up to the painter?" (Pull down on the rope) Have the text read, and in answer to the question be sure pupils understand that the pulley helps the painter in the following ways: the use of the pulley saves time—if it were not for the pulley, he would have to stop work while getting down and carrying up the paint; the use of the pulley saves effort, because without it he not only would have to move his body down to the ground and up again but would have to carry the bucket of paint as well.

The pupils should examine the real pulley and note the grooved surface that keeps the pulley cord from slipping off the wheel. They should compare the pulley with the wheels that have grooved surfaces on page 81. Have them thread the pulley and demonstrate that they can move objects in one direction by exerting force in another direction. The pulley may be fastened to the wooden molding above the blackboard, so that pupils can easily observe the turning of the pulley wheel as they lift a book or flag. Stress the change of direction by asking: "In which direction do we pull? In which direction does the book move?"

Page 85

Relation to the Unit: To extend understanding of the fact that the single, fixed pulley is a convenience in exerting force to move objects.

Procedure: Direct the pupils to read the question and study the pictures. Their answers to the question should indicate how they think the work would be done if a pulley were not used. It may be brought out during the discussion that the pulley not only is a convenience in doing work but that it also contributes to a worker's safety.

Extending and Enriching Activities:

1. A committee may be appointed to determine how pulleys are used in the everyday life of the community.
2. During the survey suggested in Activity 1 the pupils may observe clotheslines operated by means of pulleys. Such a clothesline can be bought in a department, hardware, or ten-cent store and may be used to demonstrate that pulleys are useful in moving objects horizontally as well as vertically.
3. The multiple pulley and the movable pulley may be presented. However, this is advisable only when some activity such as the building of a skyscraper or the lifting of hay into a loft has been observed, thus giving the teacher an opportunity to introduce them in a natural situation.
4. Pictures showing both single and multiple pulleys operating in various ways may be collected. The children should discuss the uses illustrated in the pictures. An illustration of each different use should be selected for an exhibit of ways in which work is made easy.

Page 86

Relation to the Unit: To present the lever as a machine that makes work easy.

Concept:

Levers can be used to reduce the force needed to lift heavy objects.

Information for the Teacher: In this and subsequent presentations of levers, the type under consideration is the first-class lever—the lever in which the fulcrum is interposed between the force arm and the weight arm.

It has been considered advisable at this level to limit the presentation to simple examples of this type of lever, so that pupils will have no difficulty in perceiving and understanding the function of the fulcrum. However, if the teacher feels that her pupils are sufficiently mature to understand such examples of the lever as the tack-puller or the claw of a hammer removing a nail, she may discuss them during the progress of the unit.

Procedure: After the title on page 86 has been read by the pupils, they should carefully read each section of verbal text in order to interpret the corresponding pictures. Their answers to the questions will indicate the extent of their understanding of how the pictured lever operates. The following answers may be considered satisfactory: "When the children push down on their end of the bar, the other end comes up and lifts the stone," "If the children's end of the bar is pushed down farther, the stone will be lifted higher."

During the discussion the teacher may ask these questions: "Why didn't Joe and Jane just carry the stone out of their garden? How do you think the stone was moved away from the garden spot after it was out of the ground?" (It could be moved by turning it over and over.) "How did the lever help Joe and Jane? Why did they use the smaller stone?"

Such responses as "To give them something to push down on," "To give the bar something to rest on" should be acceptable, for they indicate a beginning awareness of the function of the fulcrum. Explain that the stone on which the lever arm rests is called a "fulcrum," and have the pupils tell whether anything besides the small stone could have been used for a fulcrum. At the close of the discussion ask, "Do you think the lever is a machine? Why?" (Because it helps do work.)

Page 87

Relation to the Unit: To provide an opportunity to prove experimentally the function and advantages of the lever; to promote ability to read explanatory text as an aid in interpreting pictured situations; to promote ability to read and follow directions.

Information for the Teacher: A rigid bar of wood or metal and objects suitable for fulcrums should be provided for the experiments with levers. If a book end is used for the fulcrum in the experiment on this page and on pages 88 and 89, it must have a heavy, weighted base so as not to topple over. Several heavy books should also be available.

Procedure: Have the title read and recall the conclusion the pupils drew from the study of page 86—the lever is a machine that helps do work. Then say: "The pictures show how to perform an experiment to prove that a lever makes work easier. If we follow the directions, we can do the experiment ourselves." Stress the need, in experimentation, of reading carefully in order to determine the materials needed and the procedure to be followed.

The pupils should note that in the pictures a bar of wood is used for the lever arm and a book end is used for a fulcrum. They should decide what they can use to make their lever and should collect the books needed.

Direct the pupils to read the text and follow the directions for duplicating the experiment pictured on the page.

When the children lift the books by using one finger, one of them may say, "This is easy." Such a comment will come from a pupil who wants to demonstrate how strong he is. In order to make the children conscious that less force is exerted when a lever is used, three other books may be tied together. Then the pupils should alternately lift books with the finger and with the lever. This precaution will lead them to do the quantitative thinking that is necessary in order to perceive that the load is more easily lifted by the second method than by the first.

It may be well to discuss the need for rigidity and strength in the bar used as a lever. This can be demonstrated by using a pliable bar of wood or metal in place of the rigid one. In like manner it can be determined that the fulcrum must be suited in height and strength to the particular weight to be lifted.

Pages 88-89

Relation to the Unit: To demonstrate that the position of the fulcrum affects the amount of force required to lift a given load and the distance the load can be lifted; to provide an opportunity to use experimental procedures in order to discover answers to questions; to promote ability to read and follow directions.

Concepts:

A. The nearer the fulcrum is to the weight and the farther it is from the force, the less the force needed to lift the weight.

B. The nearer the fulcrum is to the force and the farther it is from the weight, the higher the weight can be lifted.

Procedure: Introduce the lesson by directing the pupils to turn back to pages 86 and 87. Discuss what is being used for a fulcrum in each case. Then ask: "Did Joe and Jane place the fulcrum for their lever near the weight or near the end that they pushed? Where is the fulcrum on page 87? Would it have made any difference if the fulcrums had been nearer the ends of the bars that were pushed down? How could we find out?" Pupils will probably reply that the answer can be found by experimenting. Guide the pupils in formulating the following questions that are to be answered by the experiment: (1) Does the position of the fulcrum have anything to do with how hard we have to push on the lever to lift a weight? (2) Does the position of the fulcrum have anything to do with how high we can lift a weight?

Then say: "We will find the answer to the first question by doing the experiment on page 88. We will find the answer to the second question by doing the experiment on page 89."

The pupils should see that all the materials needed are at hand. Then they should read and follow the directions for the experiment. The following obvious conclusions are to be drawn: (1) The closer the fulcrum is to the load, the less the force that has to be exerted to lift the load. (2) The farther the fulcrum is from the load, the greater the force that is required to lift the load.

Similar procedures should be followed in presenting page 89. Bring out these conclusions: (1) The closer the fulcrum is to the load, the less the distance the load can be lifted. (2) The nearer the fulcrum is to the force, the greater the distance the load can be lifted. In the discussion refer to the conclusions drawn from the experiment on page 88 and ask, "In the experiment on page 89 did it take more force to lift the load a greater distance?"

Extending and Enriching Activities:

1. The principles learned on pages 88-89 may be given further stress by the posing of practical problems such as: John wants to lift a heavy box about six inches in order to put rollers under it. He has no one to help him, and he is going to use a lever. How should his lever be arranged in order to make the job as easy as possible? The solutions to such problems should be found experimentally.
2. At this point the teacher may wish to introduce examples of other types of levers. For example, the tack-puller, the claw of a hammer removing a nail, the end of a bar being used to pry a board off a box, and a spade being used to turn up soil. In each example the pupils should note that the floor or ground, etc., serves as a fulcrum.

Page 90

Relation to the Unit: To determine the pupils' ability to apply knowledge gained experimentally; to develop ability to read and interpret statements that set forth conditions of problems.

Procedure: The children should read the text and examine the first picture. By constructing a toy seesaw with the fulcrum in the middle, they can demonstrate that equal weights on each end keep the seesaw balanced.

They should understand that the unequal weights in the second picture throw the seesaw out of balance and that this problem is solved in Picture 3 by adjusting the fulcrum. Thus a small weight (the weight of the smaller boy) lifts a heavier weight, but due to the position of the fulcrum, the heavier weight is lifted a shorter distance. Have the pupils demonstrate this solution with the toy seesaw and then ask them to turn back to page 88 and determine which of the experiments performed there helped to solve this problem.

Page 91

Relation to the Unit: To demonstrate the pupils' ability to apply knowledge gained experimentally.

Procedure: Each of these pictures and its accompanying text presents a problem based on previously learned concepts concerning the use of levers. The pupils should be able to study the page independently and arrive at a solution of each problem. Then they should indicate by rough sketches where they would place the fulcrum in order to solve the problems in Pictures 1 and 3. The solution of the second problem should be demonstrated on a toy seesaw. The solutions should then be discussed and justified, and where there is a pronounced difference of opinion, the problems should be solved experimentally.

Extending and Enriching Activity:
In the case of the last picture lead the pupils to suggest that the problem of raising the house higher may be solved by using a higher fulcrum, such as one of the blocks turned on end, as well as by moving the fulcrum (the piece of log) nearer the force. Set up a comparable problem and demonstrate the effects of using fulcrums of different heights to lift weights. Use the same lever arm in all of the experiments.

Pages 92-93

Relation to the Unit: To review major concepts previously presented in the unit; to give the teacher an opportunity to determine the pupils' grasp of these concepts.

Procedure: The pupils should discuss each picture and tell how wheels and levers are being used. It is not sufficient for them merely to say, for example, that a wheel is being used to help bore a hole. They should point out that as the larger cogwheel turns, it meshes with the teeth of the second cogwheel and that the axle of the second wheel also turns and thus forces the bit into the wood.

Extending and Enriching Activity:
Upon completion of the unit the pupils may plan an exhibit to display pictures and examples of machines that show the various uses made of wheels. Demonstrations to show how wheels and levers work may be scheduled at certain hours during the time the exhibit is open to visitors.

Word List for *How Do We Know?*

The following word list for *How Do We Know?* contains the words that have not been established during the first and second school years in the New Basic Readers of the Curriculum Foundation Series. The method employed in teaching science concepts from *How Do We Know?* does not involve mastery of this vocabulary. Therefore the number of new words on any one page is dictated entirely by the nature of the content. Pages containing more than three new words are those on which the new words are labels and appear under the pictured object or item.

UNIT 1
4 hunter
6 stuck
spider
7 beaver
teeth
8 land
10 swim
mink
14 throat
breast
page
15 cedar
waxwing
meadow
lark
song
sparrow
16 chipmunk
belly
forefoot
hind
mammals
tip
bushy
17 muskrat
deer
weasel
raccoon
opossum
18 swallowtail
feeler
thorax
abdomen
insects
19 bumblebee
beetle
monarch
dragonfly
ladybug
tiger
lacewing
22 different
27 claw
28 wrong
31 autumn
32 alive

UNIT 2
38 picnic
40 mountains
41 valleys
42 plains
flat
43 dry
desert
44 swamps
alike
South
North
45 lakes
46 streams
creek
brook
48 experiment
lowest

UNIT 3
54 soil
shade
stones
56 bean
jar
size
58 tomato
61 bud
vein
stem
roots
64 lettuce
radish
carrot
beet
celery
65 peas
onions
66 spinach
rhubarb
67 fern
locust
hickory
lily
asparagus
sweet
turnip
violet
clover
68 bulbs
cauliflower
tulip
69 cherry
squash
daffodil
hyacinth
narcissus
70 enemies
chinch
worm
lice
cucumber
71 ragweed
dandelion
plantain
chickweed

UNIT 4
73 wheels
levers
74 row
75 pencil
77 axles
load
79 monkey
81 belt
chain
fits
82 cog
83 beater
orange
squeezer
84 pulley
86 bar
farther
87 finger
fulcrum
88 difference
91 log
blocks

Appendix

Appendix

Materials and Equipment

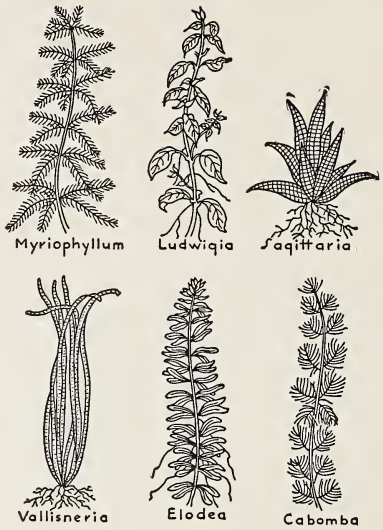
Materials listed on these pages are needed in connection with the activities suggested in the lesson plans for *Look and Learn, All Around Us,* and *How Do We Know?* Additional materials required for individual lessons are listed in the lesson plans.

The Aquarium: Every child should have the privilege of observing the complete life activities of animals and plants under their normal environmental conditions. Observation in the open, supplemented by the raising of live animals and plants in the schoolroom, will extend the child's knowledge and understanding far beyond the study of books. Such activities help develop a scientific attitude and promote desirable attitudes toward the environment.

Teachers often feel that they do not have time to take care of a group of aquatic animals. This problem is solved by means of a balanced aquarium. The following simple directions have been planned so that suitable activities may be carried on with a minimum of expense.

Materials: A square or oblong tank aquarium is the best type to use. Lacking that, the ingenious teacher will find many good substitutes, such as large-mouthed battery jars and fruit jars. Globes are not so desirable as other types, for they distort the appearance of animals and break easily. Thoroughly clean sand, natural objects that are found in streams (such as attractively colored pebbles that have been shaped by water action), and the proper kinds of plants and animals are essential for stocking an aquarium. A small net and rubber tubing for a siphon are necessary for dipping the animals and changing the water.

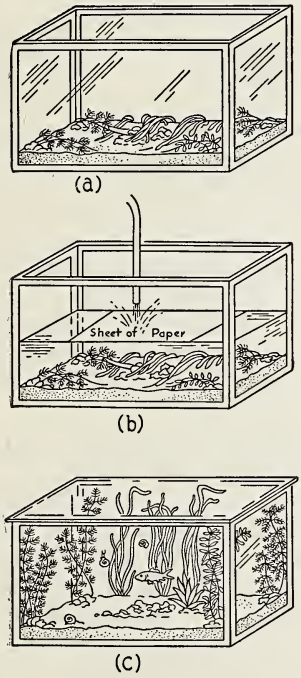
Plants: The close observer in the field will need no special instruction as to the types of plants desirable for the aquarium. Eelgrass, water milfoil, pondweed, water cress, and certain kinds of algae can be collected from the habitat where they are growing and placed in the tank to grow under similar conditions. A florist or pet shop can furnish such cultivated varieties as those illustrated.



Animals: A good caution is not to overstock the tank. For fish, the rule is "one inch of fish to one gallon of water." This does not include insects, tadpoles, etc. The number of these animals depends on the size of the aquarium. An average proportion is one gallon of water for one one-inch fish, one tadpole, one snail, and several water insects. Goldfish should be used in the school aquarium if native types cannot be obtained. Some native fish that thrive in an aquarium are catfish, mud minnows, sticklebacks, and perch. Snails of the common fresh-water type are desirable as scavengers. Clams and fresh-water mussels should be used if possible. One is usually sufficient for an average tank. Very small turtles (one inch in diameter across the back) may be added. They must be well fed to keep them from attacking other animals. Rocks that will project out of the water must be provided,

so that the turtles can get above the water to breathe. Bullfrog tadpoles and newts or salamanders may be taken from springs and streams. Desirable insects are dragonfly nymphs, back swimmers, water boatmen, water striders, and whirligig beetles. Care must be exercised with predacious insects, as they often attack other animals.

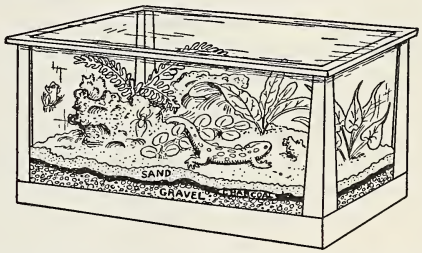
Setting up the Aquarium: Clean the container thoroughly. Put in a one- to two-inch layer of clean sand. Place the aquarium where it is to stay permanently. The most desirable place is one where it will not receive much direct sunlight but plenty of diffused light, such as near a north window.



In arranging the plants and natural objects try to make them resemble a natural pond. Anchor each plant in the sand at the bottom of the aquarium by embedding about an inch of the base of the stem and placing pebbles around the base. The upper part of the plant can then be allowed to lie flat on the sand, as it will straighten to an upright position when the water is put into the aquarium (Figure a).

Place a large piece of paper over the plants and the sand and gently siphon the water in on top of it (Figure b). The paper will prevent displacing the sand as the water is poured in and should be removed when the aquarium is filled. Use water from a spring or clear stream, as tap water often contains chemicals that are harmful to animal life. Let the aquarium stand for several days until the plants adjust themselves. Then put in the animals. (See feeding directions under Care of Animals, page 165.) *Caution:* Watch the aquarium closely. The water may have to be changed often at first. Animals use the oxygen of the water for breathing, while plants use the carbon dioxide which is a waste product of animal life. Plants manufacture oxygen. In this way the balance of aquarium life is maintained. Do not overfeed animals. Remove dead animals and plants immediately.

The Terrarium: A moisture-tight container is best suited to terrarium construction. Like the aquarium, it should be either square or rectangular because of the better view afforded. If the straight-sided type cannot be had, any glass jar or container may be used. The larger ones are more desirable. Use a piece of plain window glass for a cover.



Almost any plant that grows in the local environment may be raised successfully by simply noting its growing conditions and reproducing them as nearly as possible in the terrarium. Delicate plants may be made to live for long periods in a properly regulated terrarium. The secret of success lies in controlling the moisture by means of a tight glass cover. Plants which require little or no moisture may be kept in containers with screen or glass covers.

The terrarium should be placed where it will receive plenty of light and, if possible, a little early morning sunlight. Care must be taken that it does not receive enough direct sunlight to make the plants "scald" because of too high

temperatures. A northeast window is ideal for the average terrarium. Place the container in the location where it is to stay and leave it, as continual moving of the container is bad for both plants and animals.

Ordinary room temperatures are suitable for plants and animals usually found in the vicinity. If the temperature of the schoolroom falls very low over weekends, very little success can be expected. An average nightly temperature of 50° and a daytime temperature of 75° will give good results.

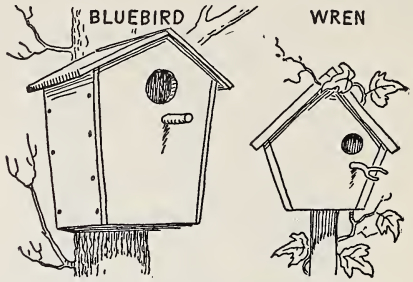
One of several kinds of habitats may be reproduced in the terrarium, but only a few of the most common types will be discussed here. First establish those that match the environment near the school and those with which the pupils are most familiar. As interest grows, other kinds may be established.

The Woodland Type: In the bottom of the container place a layer of sand or coarse gravel about an inch and a half thick. On top of this spread a half-inch layer of charcoal and then a layer of loose, rich humus from the forest floor. On field trips to deep woods select small plants for the woodland terrarium. A small salamander (land type) and two small toads may be placed in it. Feed the animals as directed on page 165. Keep the terrarium covered with glass and exclude the most direct rays of sunlight.

The Marsh Type: Place a layer of gravel on a slope, so that it will be about four inches high at one end and about an inch high at the other. Cover this layer with charcoal and with rich, moist earth from a bog. Put in plants that require much moisture—mosses (sphagnum is good), small clumps of marsh grass, and similar plants. Place the plants (see Setting up the Aquarium, page 160) and put water in the lower end to a depth of two inches. Animals such as small turtles, a small fish or two, small frogs, etc., will complete the animal life. Feed them as directed on page 165 and keep the terrarium covered.

The Desert Type: Construct this kind of terrarium when a study of conditions prevailing in very dry countries is desirable. Use coarse gravel covered with sand as a base. Place small cactus plants of various types in natural positions. Cover the roots completely. Water the plants very sparingly once every two or three weeks, as they tend to decay if watered too often. Keep a small pan of water in one corner for the animals to drink from. Animals such as horned toads and fence lizards may be kept successfully. Feed as directed on page 165. Cover the terrarium with screen wire.

Feeding Stations, Bird Bath, Birdhouses: Birdhouses will vary to fit the needs of different kinds of birds.



A satisfactory feeding table can be made from a wooden packing box. Provide a slanting roof and leave at least two sides closed for protection. Mount it on a post where it can be easily observed from the schoolroom. Another type is illustrated on page 36 of *How Do We Know?* Birdhouses, feeding stations, and the bird bath should resemble natural conditions as nearly as possible, should be safe from cats, and should be put where they can be seen by the pupils.

The Insect Cage: Grow some plants from seed corn, wheat, clover, grass, etc., in a large pot of earth or transplant weeds or other plants suitable as food for the insects being kept. Press a large lamp or lantern chimney into the soil, fitting the plants and a small container of water inside it. Put the insects inside the chimney and close the top with wire screening or mosquito netting. When the insects have eaten all the food within the container, move them to a new pot of plants.

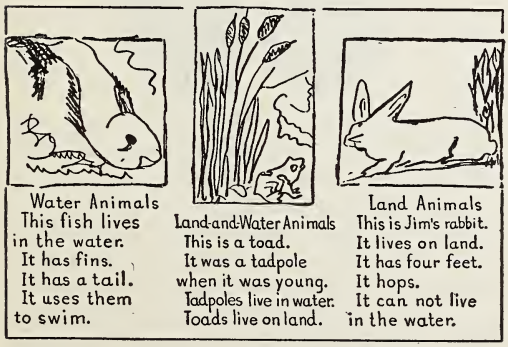
Very early in September look for the caterpillar of the monarch butterfly on the common milkweed plant. It is striped with yellow, black, and white, the stripes going around the body. It is usually found on the under surface of the leaves or in the newly opening leaves at the top of the plant. Take the stalk of milkweed with it and keep the plant in water. The caterpillar will stay on the plant.

When it is about an inch and a half long, it will attach itself to the midrib of the leaf and turn into a jade-green chrysalis with black knobs and gold spots; in about two weeks the butterfly will emerge. It should be set free after a day or two to go south with others of the same kind.

Charts and Posters: Throughout the *Guidebook* it is suggested that charts and posters be used to concrete ideas, to keep records, to retain ideas that lead into the work of a new unit, to present the group's work in fairs and exhibits, and for many other purposes. Charts may be lettered by the teacher or by a pupil but should be illustrated by the pupils with drawings, cutouts, prints, spatter prints, snapshots, or clippings they have collected. If the teacher does the lettering, it should follow reader style as to spacing, phrase breaks, etc.

Suggested captions for some primary-science charts and posters are as follows: Animals That Are Hatched, Mother and Baby Animals, Farm Animals, Zoo Animals, Animals That Swim, Animals That Fly, How Animals Grow, Machines Do Work, Machines That Help Mother, Machines That Help Father, Machines That Are Toys, Windy Days, Cloudy Days, Wind Is a Helper, Things We Do in Summer—Fall—Winter—Spring, Animals in Winter, Birds That We Know, Leaves, Spring Flowers, etc.

A typical primary-science chart, illustrated by the pupils and lettered by the teacher, is illustrated here.

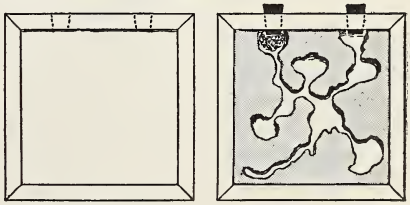


The Collecting Net: An insect net should be used for catching flying insects and for dipping insects or other small animals out of shallow ponds and streams. One may be made of cheesecloth or net. It should be eighteen inches deep and at least nine inches in diameter.

Insects such as grasshoppers, beetles, and bugs may be placed in insect cages. The more delicate insects, such as moths, butterflies, lacewing flies, etc., should be placed in glass jars. Cover the mouths of the jars with coarse cloth. The insects should be released after the children have had an opportunity to observe them carefully.

In case a permanent collection of insects seems desirable, the insects may be killed quickly by means of the fumes of a cleaning fluid. Use a wide-mouthed glass jar that has a screw lid, such as a mustard or jam jar. Hollow out one end of a large cork and glue the other end to the underside of the jar lid. In the hollowed-out end of the cork place a piece of cotton soaked in cleaning fluid. The glass jar should be kept tightly closed except when insects are being placed inside it. After the insects have been killed, they may be pinned to a mounting board for study.

The Ant Nest: An ant colony makes an interesting study for children. A house or nest can be constructed as illustrated below. Use two pieces of glass, held one eighth to one quarter of an inch apart by strips of wood glued around the edges. Place one piece of glass flat on a table and glue one-quarter-inch strips of wood around three edges, using water glass or glass cement. On the fourth side leave two openings (Figure a). After the glue is dry, fill the frame with a mixture of sifted loam and sand, leaving a space in the centre for the ant colony and spaces near the two openings in the one side of the frame which are to be plugged later to keep the ants in (Figure b).



(a) (b)

Ant colonies may be found beneath logs or stones, or in underground nests in gardens and lawns. When a colony has been found, look carefully for a queen or two. The queen can

be identified by her large size. With a trowel, scrape up a queen and as many of the other ants, eggs, and larvae as possible and take them home in a glass jar with a tightly screwed lid. Place the ants in the centre space left in the ant house. Then glue on the top piece of glass. In one of the holes in the frame place a small sponge, which must be kept wet, as ants cannot live without moisture. The other hole is for food. Bind all the edges with adhesive tape. Then plug the two holes with removable stoppers. Feed the ants from time to time, dropping bits of meat, bread, grains, sugar, drops of honey, and dried insects into the food hole. Keep the frame covered to exclude light for a day or two. By then, the colony will be established and can be observed.

The Garden: Children should be interested in plants as living things needing food in order to thrive and grow. Such interest is fostered through personal experiences in caring for plants. There is no better project for the application of knowledge concerning desirable growing conditions for plants than an outdoor garden. The lesson plans in Unit 3 of *How Do We Know?* give detailed instructions and suggestions for this activity.

Indoor Plants: In addition to their value as experiential material for children, plants have decorative values and can make the schoolroom a more pleasant place in which to work.

Potted Plants: For windows with good light—flowering begonia, coleus, desert plants, flowering bulbs, impatiens (commonly called "everbloomers"), geranium.

For windows with north light—asparagus or Boston ferns, grape ivy, Boston ivy, begonia (foliage varieties), philodendron.

The Window Box: Plants in different stages of growth—seeds just sprouting, very young plants, flowering plants, and those producing seed—may be grown in window boxes.

Make a box that is long enough to fill the window space it is to occupy. Use planks that are one foot wide for the sides and bottom and a one-foot square for each end.

Several holes should be bored in the bottom to provide drainage. Pieces of screen wire should be placed over the holes to prevent the soil from sifting through. Place a layer of coarse gravel at least an inch thick in the bottom of the box and then add rich, loose humus to within an inch of the top of the box.

The soil should be finely pulverized and in a moist condition before the seeds are planted. When the seeds have been planted, moist newspapers should be kept over them until they have germinated. Such plants as petunias, French marigolds, and sweet alyssum may successfully be raised to the flowering stage in the schoolroom. Tomatoes, calendulas, and zinnias can be transplanted to the garden.

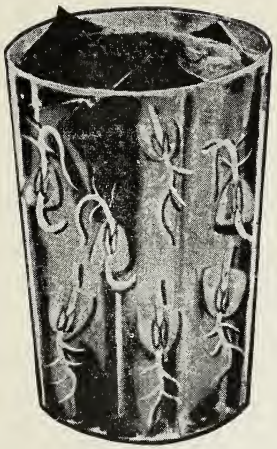
Carry the activity to the flowering and fruiting stages of plants, to present a complete idea of the life cycle of plants. Lettuce, radishes, zinnias, marigolds, etc., grow and seed quickly.

Seeds: The pupils will be interested in the manner in which the seeds for their garden sprout and grow. While there should be no discussion of food-making in plants at this stage, it is not only permissible but advisable to show how seeds are equipped for growth. Use large seeds such as dried limas, navy beans, or nasturtium seeds. Soak overnight and then carefully remove the outer coating. Split the seed and allow the children to inspect it. They can see the large fleshy parts of the lima bean. These are the seed leaves and contain stored food for the tiny plant which the children can also see.

In order that the pupils may understand that the roots grow downward, plant corn, lima beans, or other large seeds in a glass jar. Line the jar with moist blotting paper. Put corn or other seeds between sides of jar and blotting paper. Fill interior of jar with sand or sawdust. Plant seeds so that they may be seen in a variety of positions. Plant them about one inch apart. Place the jar in a warm place and keep moist but not too wet. Time for sprouting, 4-6 days.

It is advisable to work with large seeds at this level because they are easily seen and handled by children. However, very small seeds, such

as mustard, snapdragon, petunia, etc., should be used now and then in addition to the large seeds. This will avoid any erroneous ideas about the relation of size of seed to germination and growth. Tiny seeds germinate readily on damp cotton or moist blotting paper. Allow 4-6 days.



Elements of Plant Growth: To demonstrate to the pupils that there are certain requirements for successful plant growth, stress the need for light and water by giving one plant water, one no water, one plant light, and one no light. Use seedlings for this work (pots of lima bean seedlings are very good) rather than older plants with well-established root systems and allow 1-2 weeks for the experiment.

Trees and Shrubs: It is helpful to have branches of trees or shrubs available for study just when they happen to be dormant. If this occurs, branches can be forced. Use a sharp knife when cutting them from the parent plant and make a diagonal cut so as to give the largest possible open surface for water-absorption. Place the branches in water. The length of time required for forcing depends upon several factors, but these intervals are broadly correct: apple, pussy willow, weeping willow, 6-10 days; lilac, 8 days; forsythia, 10-14 days.

While it is possible to force branches, the pupils will be somewhat hampered in observing likenesses and differences in trees where leaf identification is involved. (See page 63 of *Look and Learn.*)

Plant Collections: Most children love to collect, and should throughout the year be encouraged to collect leaves, seeds, seed pods, etc.

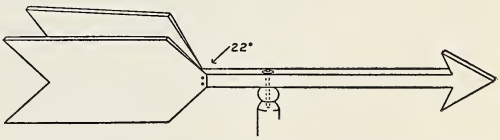
Leaves and many flowers may be pressed between heavy books or other weights and then mounted with scotch tape on posters or in notebooks.

To make an interesting and decorative leaf plaque, fill (to half way) a small pie tin with moist clay. Firmly press a leaf on the clay so that the veins and outline can be seen clearly. Remove the leaf and brush the surface of the clay with soapsuds. Pour plaster of paris which has been mixed with water into the tin. A hanger can be made by inserting a looped string or small wire. When the plaster has hardened, remove the pie tin and the moist clay. Now wash the plaster of paris gently and let dry. The leaf impression may be painted—tempera (poster) paints give the most satisfactory results.

To make leaf outlines, place a leaf on a piece of paper. About six or eight inches above the paper, hold a piece of wire screening. Then dip a toothbrush in ink and brush lightly across the screen. A delicate leaf outline results.

The Thermometer: In the experiments in Unit 3 of *How Do We Know?* the pupils will have occasion to use a thermometer. The keeping of a weather record also requires its use.

The Wind Vane: The direction of the wind is a significant feature of the daily weather record. Pupils should obtain this information from a wind vane.



Cut an arrow about twenty inches in length and two inches wide from a thin strip of soft, light wood such as white pine. From thin wood cut two tailpieces, eight inches long and three inches wide, and nail to the end of the arrow, on each side of the shaft. Spread these apart to about a 22° angle so that they will catch the wind easily. Find the balance point of the completed arrow and drill a hole edgewise through the shaft at that point, making it large enough to turn easily on a long, slender nail. Place the arrow on the nail, add a large

glass or wooden bead to serve as a bearing, and mount on a ten-foot pole or post away from buildings. Nail pointers to the post to indicate directions, using a compass to locate them exactly.

The Relief Map: To help teach the land forms in Unit 2 of *How Do We Know?* mold these forms in a paste made of salt and flour. On heavy cardboard outline the map to be made. Shellac the cardboard to prevent absorption of moisture from the salt-flour paste. Mix two cups of salt and one cup of flour with water (about one cup) to the consistency of heavy dough. As salt absorbs moisture, adjust the quantity to humidity conditions — less in moist regions and more in dry regions. Mold the paste to show desired features. When the map has dried thoroughly, color it with water colors.

Care of Animals

The children should be taught to care for the animals in the pet room at school, and they should be made to feel responsible for their comfort and welfare. The following points should be stressed:

Quarters: Provide roomy and comfortable quarters for every animal. The aquarium and terrarium take care of this problem in the case of animals that are fitted to live in them. Cages of screen, hardware cloth, or other material should be provided for mammals and birds. The cages must be cleaned daily, or the pets will become diseased. They should have removable bottoms for cleaning facilities and stationary containers for food and water. Line them with newspapers or other material that may be destroyed. Provide straw or comfortable boxes for mammals to sleep on. Mammals should not be kept indoors for more than a day or two at a time.

Water: Give the animals fresh water daily.

Feeding: Feed them daily. Remove the surplus food after the animals have eaten. Provide plenty of food; the animals will not overfeed. There is no more pitiful spectacle than half-starved animals in a laboratory.

Delicate animals, such as guinea pigs, should be fed twice daily and at regular times. Early morning and late evening are best. On Saturdays provide enough to last over Sunday. Cold-blooded animals, such as frogs, lizards, swifts, turtles, etc., do not require as much food as warm-blooded animals. Once a day is ample. A large feeding every other day is sufficient in most cases. Do not leave uneaten food to foul the water in the aquarium.

Vary the diet to prevent weakness and disease. The following food list is suggested:

Snails: Lettuce leaves, aquatic plants, powdered meat, powdered cuttlefish bone

Fishes: Prepared fish food, chopped beef, particles of earthworms

Salamanders and lizards: Flies, earthworms, chopped beef, liver

Frogs: The diet varies with the kind of frog. Insects, fruit flies, roaches, earthworms, larvae, chopped beef, very small strips of liver, etc.

Turtles: Overripe fruit, lettuce, clover, carrots, strips of liver

Snakes: Small frogs, mice, lizards, beef, liver, chicken scraps

Rats and mice: Table scraps, cheese, wheat-flour paste mixed with milk, pinch of salt and lime, dried yeast, lean meat, lettuce

Guinea pigs and rabbits: Plenty of succulent green vegetables (at least body weight daily), carrots, turnips, apples and apple parings, apple cores, pear peelings, tomatoes, water cress, wheat and oat shoots, clover, different grasses, dry grain, and sweet hay (Rabbits need twigs with bark for gnawing occasionally.)

Care of Plants

Temperature: A daytime temperature of 65°-70° and a night temperature of 55°-60° is desirable in the schoolroom for normal plant growth. When the outside temperature is excessively low, protect the plants from freezing by placing newspapers between them and the windowpanes.

Water: Water the plants only when they need it—when the soil is dry. Enough water should be given at one time to wet the soil to the bottom of the pots. Then wait until the soil is dry before watering again. Sprinkle the leaves thoroughly once a week in order to keep them free of dust and soot.

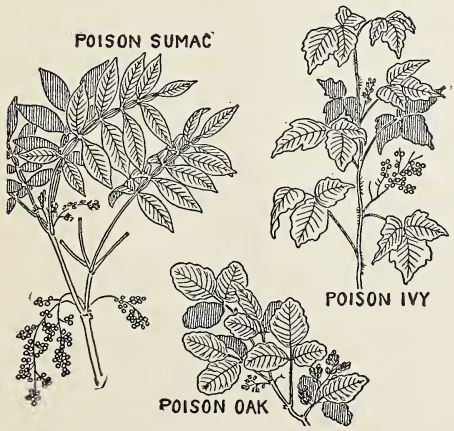
Soil: (See suggestions under The Window Box, page 163 of this *Guidebook.)*

Pests: Plants are frequently attacked on the underside of the leaves by small green lice, mealy bugs, and scales, which are lice with a hardened outer covering. To rid the plants of lice and mealy bugs, wipe the under parts of the leaves with soapy water made with a mild soap. Scales can be removed only by using a toothpick or a dull, pointed knife to lift them. Then wash the affected parts with the soap solution.

Field Trips

Providing actual experience in the open with native materials is one of the best ways of applying scientific principles. Careful plans should be made by the teacher before attempting any field work. Some of the factors to be considered in planning the trip are preliminary knowledge of the locality where the trip is to be made; noting and listing features for special emphasis and study; noting available specimens which may be taken; securing permission to visit gardens, fields, markets, and other places of interest; and preparing the children by discussion, picture study, and reading.

Before starting on the field trips, the teacher should warn the pupils about any poisonous plants that may be in the locality. She should show or draw pictures of poison ivy, poison oak, and poison sumach, warning the children not to touch any plant like them.



To afford protection in case such plants are prevalent and because they might accidentally come in contact with the skin, an application of laundry-soap lather on hands and face is recommended before the trip. A thorough scrubbing of the face and hands with laundry soap after the trip is also advisable.

During the trip skillful direction should be given by the teacher to help the pupils see and interpret those features contributing to the desired concepts. "What is making that noise near the pond?" (frog)

Direction in taking materials back to the schoolroom should be given. "See that caterpillar? Let's take it to school and watch it grow. What food shall we take for it?" (See The Insect Cage on page 161 of this *Guidebook.)*

Field trips to the following localities are suggested:

Woods, Park, Garden: To observe seasonal aspects; to observe birds and bird nests; to observe toads, ants, squirrels, rabbits, ground hogs, etc., and their homes; to track animals in the snow; to collect leaves; to observe wild flowers and different kinds of growing conditions for plants; to observe shade and sun, rich and poor soil, etc.; to observe land and water forms.

Farm: To observe farm animals and cultivated crops.

Zoo, Museum: To study specimens of wild animals and plants.

Lake, Pond, Pool: To observe and collect water animals and plants.

Greenhouse, Market, Store: To observe vegetables, decorative plants, and fruits.

Garden, Orchard: To observe leaves, blossoms, and fruits.

Miscellaneous: To observe machines at work.

Questions to Stimulate Picture Discussion

Relating to Things:

1. What is it called?
2. Of what is it made?
3. How was it made?
4. What does it look like?
5. Where is it found?
6. How is it like other things?
7. How is it different from other things?
8. How can you recognize or identify it?

9. What can you do with it?
10. How did it get its name?
11. What kind of thing is it?
12. What is its purpose?
13. How does it work or operate?
14. Have you ever seen anything like it? Where? When?
15. What other names does it have?

Relating to Events:

1. What is happening?
2. What has happened?
3. What do you think will happen now?
4. How did this happen?
5. Why did this happen?
6. What caused this to happen?
7. What took place before this happened?
8. Where have you seen something like this happen?
9. When have you seen something like this happen?
10. How could we make this happen?
11. How does this compare with what we saw or did?
12. How can we do this more easily?
13. How can we do this more quickly?

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for Look and Learn
All Around Us
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The teacher should write for a complete descriptive list of illustrated booklets in this series.

Pearson, T. Gilbert (Editor-in-Chief). *Birds of America.* Garden City, New York: Garden City Publishing Company, Inc., 1936.
A scientific compilation giving technical descriptions and accurate data.

Peterson, Roger Tory. *A Field Guide to the Birds.* Boston: Houghton Mifflin Company, 1947.
A handy guide and reference book.

Pease, Eleanor Fairchild. *Book of Horses and Their Pictures.* Chicago: Albert Whitman and Company, 1949.

Pistorius, Anna. *What Animal Is It?* Chicago: Wilcox and Follett, 1947.
See also *Bird, Butterfly, Dog, Horse, Tree,* and *Wildflower* books by the same author.

Podendorf, Illa. *True Book of Trees.* Chicago: Children's Press, Inc.
See also *Weeds and Wild Flowers, Pebbles and Shells* by the same author.

Robinson, Thomas P. *Greylock and the Robins.* New York: The Viking Press, Inc., 1946.
Large four-color pictures illustrate this realistic story of how a mother robin foils a scheming cat.

Schloat, C. Warren, Jr. *The Wonderful Egg.* New York: Charles Scribner's Sons, 1952.
Life cycle of a chicken in photographs and drawings.

Schmidt, Karl P. *Homes and Habits of Wild Animals.* Chicago: M. A. Donohue and Company, 1934.
Large full-color plates and two-color drawings of North American mammals. The informal text is suitable for reading to the children.

Sears, Paul McCutcham. *Tree Frog.* New York: Holiday House, Inc., 1954.
Mating and life cycle of the tree frog.

Selsam, Millicent. *All about Eggs.* New York: William R. Scott, Inc., 1952.

———. *All Kinds of Babies.* New York: William R. Scott, Inc., 1953.

Smalley, Janet. *Do You Know About Fishes?* New York: William Morrow and Company, Inc., 1934.
Good drawings and simple, informative text.

Teale, Edwin W. *Insect Friends.* New York: Dodd, Mead and Company, Inc., 1955.
An informative book for the teacher who is interested in the early scientific work with insects.

Tensen, Ruth M. *Come to the Farm.* Chicago: The Reilly and Lee Company, 1949.
No story but good photographs of farm animals the children will enjoy identifying. Simple text.

———. *Come to the Zoo.* Chicago: The Reilly and Lee Company, 1948.
Excellent photographs of zoo animals. Simple text may be read to the children.

Tresselt, Alvin. *Autumn Harvest.* New York: Lothrop, Lee and Shepard, 1951.
See other books by the same author.

———. *Follow the Wind.* New York: Lothrop, Lee and Shepard, 1950.

———. *Hi, Mister Robin.* New York: Lothrop, Lee and Shepard, 1950.

———. *Johnny Maple Leaf. New* York: Lothrop, Lee and Shepard, 1948.
Large pictures, simple text. Story suitable for illustrating the effects of the changing seasons on a leaf and its surroundings.

———. *Rain Drop Splash.* New York: Lothrop, Lee and Shepard, 1946.
Large four-color pictures. An imaginative account of how rain travels to the sea.

———. *Sun Up.* New York: Lothrop, Lee and Shepard.
Storm on a hot summer day.

———————. *The Wind and Peter.* New York: Oxford University Press, 1948.
Black-and-white pictures and simple text illustrate the effects of the wind on weather.

Tudor, Tasha. *Thistly B.* New York: Oxford University Press, 1949.
Nice illustrations and simple text tell how two children raise a family of canaries.

Weather Bureau. *Cloud Forms.* Washington, D.C. (The teacher may send for this material.)
Good material for teacher reference and class display.

Webb, Addison. *Song of the Seasons.* New York: William Morrow and Company, Inc., 1950.
Animals the year round.

Webber, Irma E. *Travelers All.* New York: William R. Scott, Inc., 1944.
Clear, realistic drawings and simple text give information on how plants scatter their seeds.

———————. *Up Above and Down Below.* New York: William R. Scott, Inc., 1943.
Stylized drawings of many common plants. Makes very plain the root structure as well as the part that appears above the ground. Simple text.

Weisgard, Leonard. *Whose Little Bird Am I?* New York: Thomas Y. Crowell Company, 1944.
An excellent book to stress the relation of animal structures to food getting.

Whittemore, A. R. (Editor). *Conservation and Nature Activities.* Toronto: Audubon Society of Canada, 1951.
A practical guide to conservation and nature study. Well illustrated.

W.P.A. Writers' Program (Ralph De Solo, Editor). *Birds of the World.* Chicago: Albert Whitman and Company.
Authentic accounts of all bird life in the world.

———————. *Reptiles and Amphibians.* Chicago: Albert Whitman and Company, 1941.
Authentic accounts of the world's reptiles and amphibians.

———————. *Who's Who in the Zoo.* Chicago: Albert Whitman and Company, 1941.
Accurate information about a modern zoo.

Zaffo, George J. *The Big Book of Real Building and Wrecking Machines.* New York: Grosset and Dunlap, Inc., 1951.
This and the following books by Zaffo have large colored pictures. Text may be read to the children.

———————. *The Big Book of Real Fire Engines.* New York: Grosset and Dunlap, Inc., 1950.

———————. *The Big Book of Real Trains.* New York: Grosset and Dunlap, Inc., 1949.

Zim, Herbert S. *Frogs and Toads.* New York: William Morrow and Company, Inc., 1950.
Many black and white drawings. Treats the life cycles of frogs and toads, their habits, and how to care for them as pets. May be read to children.

———————. *Golden Hamsters.* New York: William Morrow and Company, Inc., 1951.
Treats the care, housing, and breeding of hamsters. Very informative. Well illustrated.

———————. *The Great Whales.* New York: William Morrow and Company, Inc., 1951.
Fascinating and simply told facts about these giant mammals. Profusely illustrated. May be read to children.

———————. *Owls.* New York: William Morrow and Company, Inc., 1950.
Accurate information about growth cycles, habitats, and habits of many species. Good black and white drawings. May be read to pupils.

———————. *Plants.* New York: Harcourt, Brace and Company, Inc., 1947.
Excellent reference for the teacher. Identification and classification. Suggestions for experiments, collecting, and studying.

———————. *Rabbits. New York:* William Morrow and Company, Inc., 1948.
Life cycles, habitats, and habits. Also care and feeding of rabbits. May be read to pupils. Many black and white illustrations.

———————. *Snakes.* New York: William Morrow and Company, Inc., 1949.
Black and white drawings of North American snakes. Life cycles, habitats, and habits. Text may be read to children.

Zim, Herbert S., and Cottam, Clarence. *Insects.* (A Golden Nature Guide.) New York: Simon and Schuster, 1951.
Two hundred and twenty-five species in full color. A reliable and handy reference for the teacher. Pupils may use the illustrations for identification purposes.

Zim, Herbert S., and Gabrielson, Ira N. *Birds* (a Golden Nature Guide). New York: Simon and Schuster, 1949.
One hundred and eighteen paintings in color. An excellent reference for the teacher.

Zion, Gene. *All Falling Down.* New York: Harper and Brothers, 1951.
Things like snow, rain, leaves falling denote changes in seasons.

Zolotow, Charlott. *The Storm Book.* New York: Harper and Brothers, 1952.
Text on page following picture.

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